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// JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

MARCH, 1934.

TRANSACTIONS OF THE SOCIETY.

PRESIDENTIAL ADDRESS.

I.—SOME RECENT ADVANCES IN MICROSCOPY.

By Conrad Beck, *C.B.E.*

(*Delivered January 17th,* 1934.)

The duty of reviewing the work of the Society during my term of office gives me a feeling of considerable pleasure and satisfaction. During this period papers have been read which describe the achievement of results which have been hoped for for many years but have only recently been accomplished. These results have produced developments which increase the power of the microscope to such an extent that they may be said to be epoch making.

We have had the paper by Mr. J. E. Barnard on the microscopy of filterable viruses, which described how, by the use of ultra-violet light and dark ground illumination, the resolution of the microscope has been more than doubled.

We have had a paper by Mr. Smiles describing a new type of dark ground illuminator for ultra-violet light, by which photographic exposures have been greatly reduced.

We have had a demonstration by Dr. Canti showing the use of the micro-cinematograph for the investigation of slow growth and development.

We have had a paper by Dr. Jones describing a new method of identifying the components of opaque minerals by the use of polarized light combined with vertical illumination.

We have had a paper by Mr. Harold Wrighton on a new oil-immersion lens with an aperture of 1·6 N.A.

The invention of the achromatic microscope by Lister and Chevalier in the early nineteenth century marked the commencement of the modern instrument as we know it, superseding the single and very imperfect lenses of Leeuwenhoek and his successors. Since then many useful advances have been made—the oil-immersion lens, the apochromatic object-glasses, the Siedentopf ultra-microscope, and the efficient employment of the substage condenser, and so forth. These improvements have enabled objects to be seen with greater distinctness—they have somewhat extended the use of the instrument, but the modern developments to which I am referring have more than doubled the resolving power of the instrument and have already resulted in the observation of a new and smaller race of organisms than had hitherto been recognized. The resolution of the microscope had reached at least 100,000 lines to the inch as far back as the middle of last century. In 1860 Col. Woodward photographed *Amphipleura Pellucida* showing transverse striæ perfectly. This limit was extended to something approaching 140,000 lines to the inch, due to the steady advances referred to during the nineteenth century, but we are now able to place that resolution at a figure that is less than 1/300,000 of an inch. Therefore, I think, we are justified in speaking of these modern advances as epoch making. We cannot forecast the development in the near future, but it may be of interest to comment on these achievements and indicate some of the details that have contributed to their success.

Dark ground illumination had been used with low and moderate powers almost from the time when achromatic microscopes were first made, but it is only in recent years that the refined apparatus required to use it with high-power wide-angle lenses has been produced. The production of this apparatus was delayed by one of those curious psychological phenomena that occasionally present themselves. A theory was evolved from a purely academic standpoint, stating that dark ground illumination could only reach a resolution of detail about half that obtained with transmitted light. This theory was largely accepted. It is reminiscent of the theory that is said to have been propounded by Charles II to the Royal Society, that a bowl of water weighed less when a fish was swimming in it than when the fish was removed. After much argument somebody tried it, and it was not so. That is what occurred in this country; the resolution with dark ground illumination was tried, and it was not half that obtained with transmitted light, but equal to it in every respect.

Apparatus was made to use dark ground illumination with object-glasses of as high numerical aperture as 1·27 and even 1·4, on specimens mounted in high refractive media. Mr. J. E. Barnard was the first to apply this illumination to the use of very wide angle object-glasses. It has chiefly been used for the examination of structure that is so transparent that it can scarcely be rendered visible by transmitted light, or by any method of illumination from above; but even with specimens that are not transparent the contrast between small objects examined against a black background

as against those seen against a white background is so marked as to give visibility to many otherwise invisible features. A thread of white cotton, unpleasantly conspicuous on a black coat, would pass unnoticed on a white apron.

The use of dark ground illumination has already led to important discoveries in the structure of bacteria, the non-homogeneous structure of protoplasm, the characteristics of filter passers, and so forth, and will no doubt reveal more in the future.

The correct interpretation of images seen or photographed with dark ground illumination is assisted by a careful study of the appearance of natural objects seen by the eye under reflected, refracted, or scattered light or under combinations of the three different classes of illumination. Illumination from above—so-called opaque illumination—tends to reveal more of the surface structure and less of the interior than either dark ground or transmitted illumination. The observation of glass rods and glass balls in the air and in fluids of different refractive indices, as described by Sir Almroth Wright in his book on the Principles of Microscopy, is a good example of what can be learnt by observation of objects without magnification. The problem as to whether structure is superficial or internal, whether apparent structure is an optical effect or not, can be often determined by analogy from such an examination.

High-power dark ground illumination has so far been applied chiefly to the study of living organisms which would no longer retain their characteristics after death or which might be entirely altered by the processes of staining and mounting. It has limitations. It cannot be satisfactorily used on objects with any great thickness. The portions above or below the layer being examined reflect so much light that no dark ground is obtained and the advantages of contrast and visibility are lost. Very few sections of tissue are thin enough to allow of its use and objects held in fluid suspension require to be mounted in as thin a film as possible.

Thus dark ground illumination, although a great factor in recent biological discoveries, does not render differential staining less important. There are many possible methods of attack in microscopical study, of which these are two. There are signs that other methods of investigation of these difficult problems are likely to be forthcoming.

It is a matter for congratulation that your Council has appointed a committee to study the question of stains and reagents used for microscopic research. Their work is at present chiefly directed to obtaining a high standard of quality, but such work generally leads as a natural consequence to the introduction of new materials and new technique. There would seem to be scope for the introduction of differential stains particularly designed for dark ground illumination. The present dyes depend for their results on the colour of the light which they transmit, and not upon the colour of the light reflected or scattered from the structure impregnated with them. Some of the aniline dyes possess such anomalous properties as regards the

light which they reflect, that it may be that colouring agents could be selected that would be useful for diagnostic purposes with dark ground illumination.

Those who have examined stained specimens of bacteria by dark ground, must have been astonished to see how vividly the tubercle bacillus stands out as a brilliant yellow against the faint red pus cells, how much more quickly it is recognized than with transmitted light, where it appears as a faint pink. The anthrax bacillus stained with methylene blue appears blood-red by dark ground. The malaria parasite within a blood cell requiring care to discover by transmitted light simply leaps to the eye by dark ground. There may be reagents or stains that would differentiate structure viewed by this means to a greater extent than can be done with transmitted light.

The use of dark ground with high powers has again drawn attention to its use with low and moderate powers, and all this diagnostic work on stained specimens can readily be done with a carefully arranged stop in a substage condenser and dry object-glasses of 8 mm. or 4 mm., provided the aperture does not exceed about 0·65 N.A.

It is not, however, dark ground illumination that has doubled the resolution of the microscope. It has more than doubled the visibility of small objects. Extra resolution might have been of but little use if the objects so resolved had been almost invisible. It is, however, the technique by which the ultra-violet light of short wave-length can be used as an illuminant that has more than doubled the resolving power of the instrument and will probably at no distant date increase it to nearly three times its previous limit. It is, perhaps, difficult to say whether visibility or resolution is the more important factor in microscopic work, but certainly both are essential, and in approaching the subject I have drawn attention to dark ground before dealing with the ultra-violet technique.

Many years ago attempts have been made to use radiations of short wave-lengths, but without any marked success, and it was not until Mr. Barnard applied himself to the development of a new technique that the method became of practical importance, and I will draw your attention to the more essential points of this new technique. The difficulties to be overcome were considerable. There are very few materials that are transparent to the ultra-violet light of short wave-length. All kinds of glass are quite opaque, only a certain number of fluids are transparent, and fused quartz is at present the only suitable material from which the lenses can be made, while the materials in which the objects to be examined can be immersed are limited. Canada balsam and most of the resinous cements are opaque. Fortunately, water and thin layers of gelatine and most of the fluids of the body are reasonably transparent.

But the fact that we are limited to the use of one material for the lenses means that an achromatic lens is impossible, and light of one wave-length alone must be used. The lenses must be corrected for that particular wave-length, and will only give the best definition for that wave-length and no other.

As the ultra-violet rays are invisible, the work must be done by photography. The image being invisible, cannot be focussed by any direct method. An analogy may be made from some of the early photographic lenses before the time when it had been discovered how to make them truly achromatic. The rays that were most readily visible did not focus to the same point as those to which the early photographic plates were sensitive, and after having focussed with visible light, the position of the lens was altered by a predetermined amount to correct the error. This cannot be done with the quartz monochromatic lens because the image formed by a non-achromatic microscope object-glass, that is corrected for one coloured light only, is so inferior when used with light of another wave-length that no definite position for its sharpest image can be determined. This problem of focussing the invisible image has been one of the chief causes of failure in the past. There are stories of 100 photographs having been taken to obtain a sharply defined picture. The problem has now been solved so that a sharply focussed photograph is obtained without difficulty every time.

The invisible image formed by the ultra-violet light can be transformed into a visible image if it be thrown upon a fluorescent material that converts this invisible light into light of a longer wave-length which can be seen, and as such fluorescent materials are well known this method was tried, but without success. If a material could be found with such powerful fluorescent qualities that a film only a ten-thousandth of an inch thick would accomplish the change from invisible to visible light, it might be used, but all known fluorescent materials require such a thick layer that the image does not exist at any definite position in them, but is distributed through a depth of material that renders them quite useless for focussing purposes.

As no direct method of focussing is satisfactory an indirect method has been devised. An object-glass was made suitable for visual observation with approximately the same focal length as the monochromatic quartz lens, and a perfect method of interchanging the two has been devised. A slow motion has been constructed that can be moved a definite amount with certainty to compensate for a small predetermined difference in focus. The image seen with the visual lens is focussed accurately, and it is then interchanged with the quartz lens and the fine adjustment moved to the required amount. This all appears simple, and would be so if reasonably large dimensions were being dealt with.

Interchangeability in ordinary engineering practice is considered not only possible but is often stipulated; but the tolerances are large. 25μ or 1/1000 inch for many purposes is considered an error that can be neglected and $2\frac{1}{2}\mu$ or 1/10,000 of an inch is considered a marvellously close approximation to perfection, but here an accuracy has to be reached that is more nearly $1/20\mu$ or 1/500,000 of an inch, and the object-glasses are required to interchange with an accuracy such that they do not vary in position by a larger amount than about this figure while the slow motion requires to be capable of moving the lens with the same accuracy. This has been accomplished. It is the

chief factor in the success of the technique. I propose after this address to put on the screen one or two pictures which indicate how it has been done.

No microscope was previously made which could approach the accuracy. The object-glasses and also the object can be removed and replaced or interchanged, and their position set to these limits. The greatest freedom from elasticity, the utmost rigidity of all the parts has been necessary, and you will, I think, agree that Mr. Barnard is to be congratulated for his courage in attempting to attain an accuracy of this degree.

We have had from Mr. Smiles a description of a special dark ground illuminator for ultra-violet light. The type used for visual purposes is of no use for ultra-violet, as silver, which is used for the reflecting surfaces, does not reflect the short wave-length light used in this work, it is almost transparent to this portion of the spectrum.

The best method of production of the spark source of light from which the light is obtained has involved much study and work to reach the required intensity. The necessity of exposing living organisms to the briefest possible illumination of ultra-violet light so as not to kill them, has called for rapid means of changing from visual to ultra-violet light and many other details are of importance, but the main secret of success is the precision of the interchangeability, the reliability of the fine adjustment, and the rigidity of the apparatus.

It will take time for it to be appreciated to the full that the power of the microscope has been doubled. I will throw upon the screen two pictures side by side. On one is a photograph of small-size bacteria, on the other is one of a filter passer associated with smallpox, and this is followed by an enlarged photograph of filter passers in which you will observe indication of subdivision by fission.

There is in science, and quite rightly so, a conservative scepticism of new advances, and they require the test of time to insure their adoption, but it is to be hoped that shortly the ultra-violet microscope will be applied to other branches of science.

A paper by Mr. Harold Wrighton, published in the December journal, describes the use of a new object-glass with an aperture of 1·6 N.A. computed by Mr. R. Bracey of the British Scientific Instrument Research Association, which resolves structure in steel approaching 1/200,000 of an inch. This is made to work with a visible wave-length at the extreme blue end of the spectrum. It does not reach the fineness shown with ultra-violet light, but is the finest recorded resolution obtained with visible light. It is interesting to note that a 1·6 N.A. lens has been made long ago, and one is in the possession of the Society, but no results comparable with that given by the new lens have been obtained with it.

In turning from the subject of resolution and visibility, we come to the demonstration by Dr. Canti which described the application of the cinematograph to microscopic study.

Can we suppose that if a microscopist fixed his eye to a microscope for

30 or even 12 hours to study the slow process of growth or development, he would gain any reliable notion of what was happening to the object observed?

Dr. Canti, by taking a series of cinematograph photographs at regular intervals of 10, 20, 30, or 60 seconds, and exhibiting them at the normal cinematograph speed of twenty to a second, shows these slow movements at a rate at which the process can be readily studied.

Could it have been supposed in the past that we should be able to watch the actual processes of the devouring and digestion of disease germs by the white corpuscles of the blood? The demonstration given at our Society was an eloquent display of what may be expected in the future from this branch of research. In a different branch of science, Dr. Jones has given us a demonstration of a new application of the Petrological Microscope to Mineralogy. By the use of vertical illumination, combined with polarized light, the composition of many opaque minerals can be determined. The polarized light reflected from a polished surface of such opaque minerals has entered the material to a sufficient extent before reflection to emerge with many of the optical characteristics that would have been displayed if light had passed through a transparent section of a material with similar properties.

This enables many ores to be identified at once that would otherwise require elaborate chemical analysis.

A further paper to this Society to which I have not referred is that by Prof. Hartridge on his new Micro-Projector. This method of exhibiting microscopical preparations to an audience has recently come so much to the fore that I propose to put on the screen at the close of these remarks three specimens kindly lent by Mr. Barnard to call attention to this branch of the subject.

These papers, which do not touch on the many varied uses in which the microscope is now being employed in other sciences and industrial work, are proofs of the amazing rapidity with which the powers of the instrument have recently been developed.

Let us not forget that these advances have been communicated to, discussed, and published in its journal by the Royal Microscopical Society. Our Society has always held the most prominent position in the world for its publication of microscopical theory and practice, and may I be forgiven if in concluding this address I wander for a moment into the realms of speculation.

Let us dream for once as to what can and should be done by our Society to encourage or share in the intense vitality that has arisen of late in this direction.

We shall not overstep the mark if we say that the British have led the way in this branch of science since the War, and it is to be hoped that they will continue to do so.

It is unfortunate that for most of this work, the apparatus required is

exceedingly costly. Perhaps as the work becomes more and more intricate it will always be so. It is not probable that the most elaborate outfits will be installed in large numbers in laboratories or in a great many industrial undertakings. It raises the question as to how such work is to be carried on. The question of cost has not stopped the advance of Astronomical Science. It has, no doubt, restricted the activities of amateur astronomers, but the work is carried on in endowed institutions with the dignity of Astronomer Royal attached to the chief observer.

Is it for our Society to consider whether they would be in favour of a similar procedure for microscopy, and if so, whether they should work for such a result?

I can understand objections that may be raised to a professional element in this study. Some might think that it might tend to become academic and comatose, but a study of recent astronomical progress shows that there is no fear of this if the right men are chosen for the work. What is required is study of the application of the instrument on modern lines for all classes of work, and the establishment of laboratories where the more difficult examinations can be carried out for all the branches of science which require microscopic work. The enthusiastic amateur is sometimes not debarred by cost, but he requires a training of a very varied and comprehensive character which he can scarcely be expected to possess, unless he has devoted a great part of his life to scientific study.

I express no definite opinion on this subject, but I am anxious to draw attention to the rapid, one might say almost over rapid, way in which our science, like so many other sciences, is becoming the work for highly trained specialists.

In some sciences, such as the medical profession, a period of training is prescribed, after which a degree is given, which is at any rate a guarantee that the recipient has spent a number of years in studying his subject. I have heard suggestions that our Society should grant a Fellowship that should imply some such guarantee.

It would presumably be done by some form of examination. I am not greatly impressed by examinations, unless they are simply a guarantee of a continuous course of previous study. I expect that the Society would not at this stage be prepared to actively consider this matter, but the future has, no doubt, much in store for us that we can only dimly foresee.

It may be, at any rate, a fruitful pastime to allow our minds to explore these pathways of conjecture. It is as the offspring of such conjecture that future action is born.

II.—MICROINCINERATION STUDIES OF THE LIVER IN RIFT VALLEY FEVER.

By E. S. Horning, Beit Memorial Research Fellow, and G. M. Findlay.

(From the Laboratories of the Imperial Cancer Research Fund and The Wellcome Bureau of Scientific Research, London.)

(*Read March 21st, 1934.*)

Three Plates.

Introduction.

Routine cytological procedures have as yet yielded little data concerning the chemical nature of the intracellular "inclusion bodies" caused by the selective action of certain filterable viruses upon animal and plant tissues.

Although much emphasis has been placed on the morphology and staining reactions of these bodies under experimental conditions, their complex intracellular pathology is not well understood. The advisability, therefore, of investigating them by means of a new technique is apparent.

With this end in view the object of the present study was to determine, by microincineration, the localization and inorganic composition of the inclusion body formed by the Rift Valley fever virus, as well as to ascertain its behaviour during the extensive phases of liver necrosis caused by the virus.

Material and Technique.

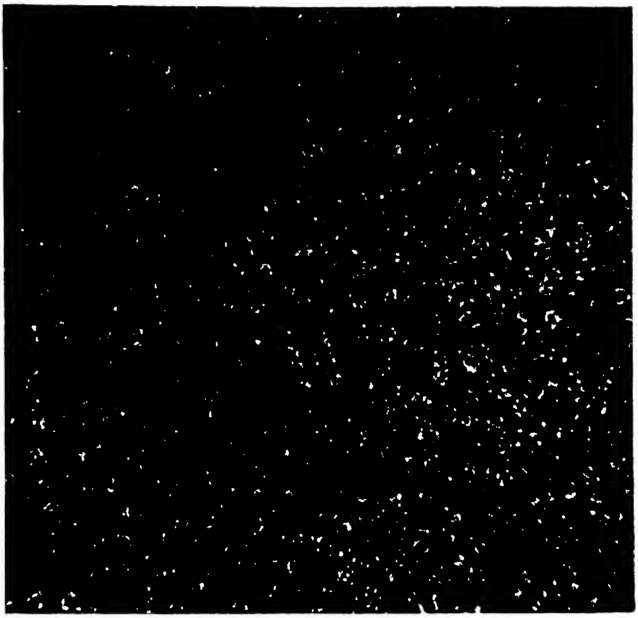
For the purposes of microincineration small pieces of liver obtained from mice, 12, 24, and 48 hours after inoculation with 0·25 c.c. of a 1 in 10 suspension in citrated saline of blood from a mouse dying of Rift Valley fever, were fixed for 24 hours in a solution containing 9 volumes of absolute alcohol to 1 volume of neutral formalin. In several instances livers were selected from mice that were moribund 48 hours after inoculation. Livers of mice not infected and belonging to the same strain were used as controls. Liver necrosis experimentally produced by injections of carbon tetrachloride into normal mice was compared with the degeneration associated with the Rift Valley fever virus. Material was obtained from mice 24 hours after an intraperitoneal injection of 0·025 c.c. of CCl_4 and 48 hours after a dose of 0·01 c.c. As it is necessary to ensure complete dehydration and to remove the formalin from the tissues prior to incineration, the tissues were passed through several changes of absolute alcohol before clearing in xylol and embedding in paraffin. Sections were cut at a thickness of 4μ, and in order to avoid

any contact with water they were smoothed out by floating on absolute alcohol. Alternate sections were kept for incineration while the remainder were mounted in the usual fashion with egg albumin, serving as controls after staining with Ehrlich's hæmatoxylin. The sections for micro-incineration were placed on a quartz slab and incinerated in a special electric quartz oven at temperatures varying from 625° C. to 650° C. for periods ranging from 45 to 55 minutes. During this procedure the temperature was gradually increased by approximately 70° C. every 5 minutes. The incinerated preparations after cooling, in order to avoid absorption of moisture, were mounted merely by placing a thin cover-glass over them and sealing its edges with paraffin. The general appearance of the mineral organization in the tissues was studied in dark-field illumination, obtained by a Zeiss cardioid condenser with Köhler's method of illumination (a Zeiss microscope filament lamp provided with an aspherical condenser, an iris diaphragm, and a frosted blue glass screen). The distance between the filament and the mirror of the substage condenser was approximately 12 inches.

The incinerated and stained control sections were studied with a Zeiss "Bitukni" binocular tube attachment. For high-power observations of the incinerated sections an apochromatic homogeneous oil-immersion objective 60, num. apert. 1·0, with iris diaphragm and paired compensating oculars 10×, were used.

Before examination in dark-field light the incinerated sections were studied in direct illumination, in order to ensure that incineration was complete. In the case of liver this is found to be essential, as the nuclear material incinerates less rapidly than the rest of the cytoplasm. As carbon appears black in transmitted light any incompletely incinerated residues were thus detected.

The striking histological distribution of the inorganic ash in the incinerated preparations demonstrates the close association between the organic and inorganic material of the tissues. Photomicrographs of living cells taken by Scott (1932) by means of ultra-violet light of a wave-length of 2,750Å revealing an absorption of these rays in areas which on incineration show deposits of inorganic material, suggest such a phenomenon, but by no means prove that the distribution of salts in incinerated preparations closely resembles their distribution in living cells. The optical differentiation of ash in incinerated tissues by their colour values, as seen in dark-field illumination, should, with certain exceptions, be accepted with extreme caution. Calcium and magnesium appear to be present in the form of oxides and leave a white ash, but they cannot be differentiated from each other, although Policard and Ravault (1932) point out the possibility of recognizing magnesium in such material when it is subjected to spectrographic analysis; the technical difficulties are, however, still so great that real chemical accuracy seems lacking. The presence of calcium after incineration can be detected by the gypsum reaction described by Moreau



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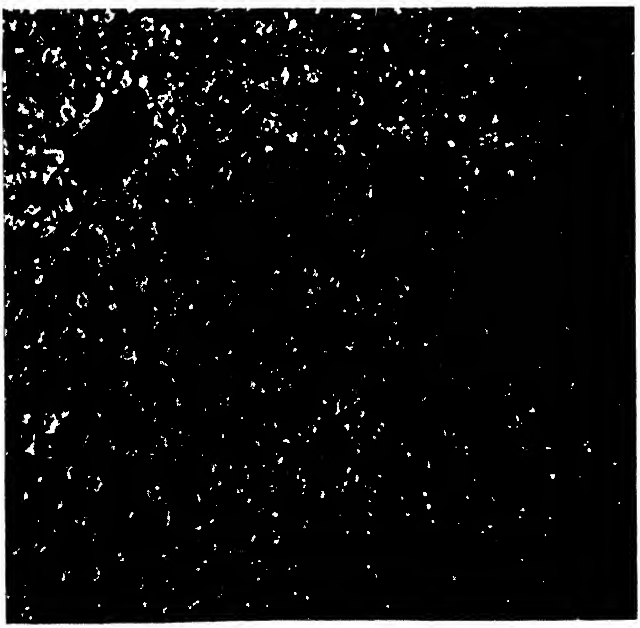

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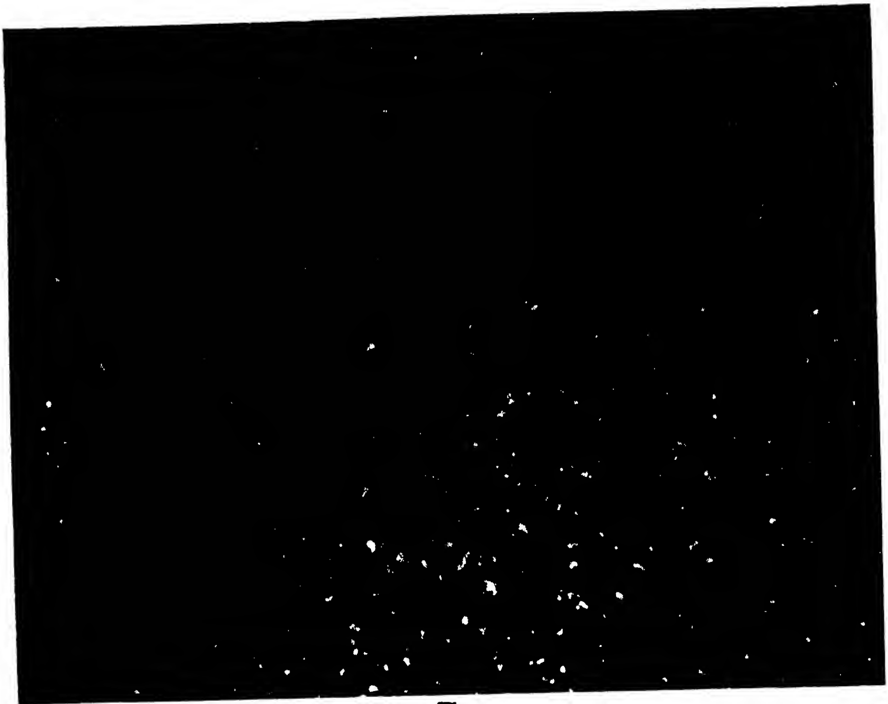

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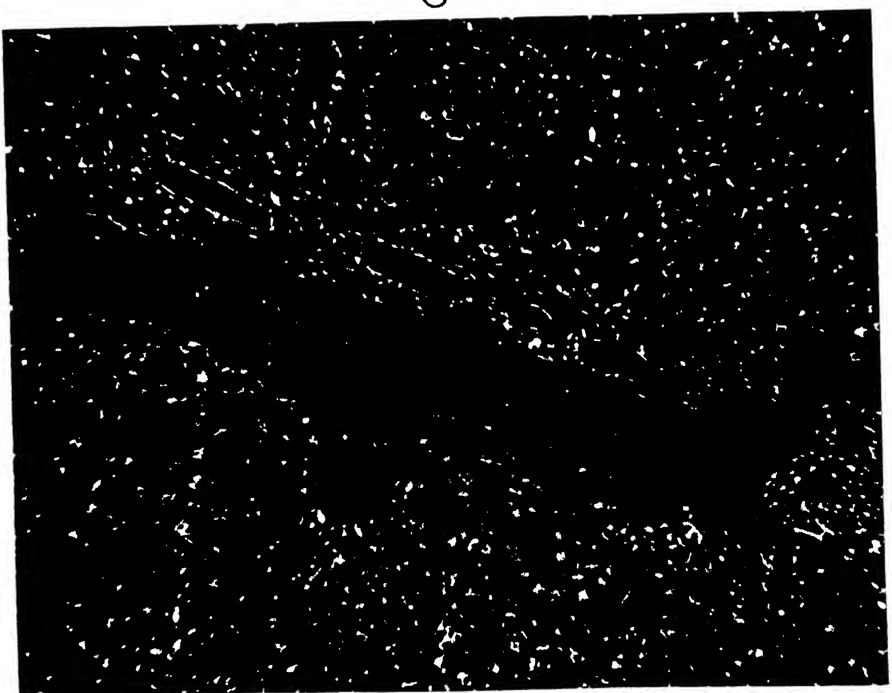

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(1931). The crystalline structure of silica and its double refraction when viewed by polarized light make its presence distinguishable if in high concentration. Scott (1932), in his review on the localization of mineral salts in incinerated tissues, points out that the presence of iron oxide, as indicated by its colour value in dark-field light, must be interpreted with caution. In this connection Policard (1932) contends that its colour, in incinerated material, varies from yellow to red, deep red indicating the presence of free iron. But as any carbon residue in the sections may yield similar colour values to those given by ferric oxide in dark-field illumination, it is necessary first to examine the preparations in transmitted light for traces of carbon before proceeding to detect the iron.

In the present state of our knowledge it appears impossible to localize with certainty either potassium or sodium in tissues by means of micro-incineration. In this respect Policard and Pillet (1928) have put forward several suggestions, which are open to criticism. They contend, for instance, that sodium can be identified in dark-field light by its bluish-white sheen, but Mason (1931) has recently shown that this colour value may be caused by the physical and not by the chemical properties of the ash.

Observations.

Observations of the incinerated sections of liver show a remarkable ash distribution when compared with the stained control preparations. The incinerated tissues retain their morphological values to such an extent that they can be recognized histologically by their inorganic remains when viewed in dark-field illumination.

The organization of the mineral salts in normal healthy incinerated liver is shown in fig. 1. Under a high, dry objective the cell membranes of the liver parenchyma cells are represented by lines of white inorganic residue of unequal thickness caused by the slight clumping of the ash. The inner surface of the cell wall presents a more uneven surface than the outer.

A concentration of white ash forms a clear outline of the nuclear membrane. As a rule the cytoplasm of the normal healthy cells reveals little organic composition, but small concentrations of greyish ash forming variable patterns may occasionally be detected.

Examination of the corresponding control stained preparations suggests that these mineral deposits, owing to their form and position in the cytoplasm, may possibly represent a concentration of salts around either the periphery of the intracellular canaliculi or the fat globules. The nucleoplasm, except for the aggregations of mineral salts representing the inorganic residues of the chromatin and nucleolus, is devoid of ash. The mixed oxides forming the chromatin and those derived from the nucleolus can be optically differentiated from each other. The former yields a white ash, the latter consists of a more compact mineral deposit generally showing a glittering

yellow tinge. Cell-types other than the parenchymatous components of the liver can be recognized after incineration by their specific mineral organization, though the investigation is restricted to the parenchyma cells in which the inclusion bodies are found. Small organized deposits of ferric oxide representing the remains of the Kuppfer cells are frequently seen in the sinusoids. The endothelial cells of the interlobular veins contain a highly refractive mineral residue, and the liver cells surrounding the central vein are generally richer in inorganic material than those nearer the periphery of the lobule.

Findlay (1933), in a recent paper, has shown that the intranuclear inclusions associated with Rift Valley fever virus are well developed and can be best examined some 24 hours after inoculation, as the liver necrosis has not then become general. It was therefore advisable, in order to observe any inorganic differentiation of the intranuclear inclusion within the nucleoplasm of the liver cells, to select material for incineration at this period after inoculation. Preparations of incinerated liver from mice 24 hours after inoculation with the virus, when compared with similarly treated sections of liver from normal mice of the same strain, show interesting differences in their inorganic organization.

Observations, under the lower powers, of liver incinerated 24 to 30 hours after infection of the virus reveal changes in the localization of the mineral salts. The inorganic residues forming the remains of the cell boundaries adjacent to the sinusoids consist of a more highly refractive white deposit containing siliceous particles ; the cell walls are shrunken and the cytoplasm contains numerous disorganized clumps of calcium material (*see* fig. 2).

Another interesting difference, especially noticeable in the central portions of the lobules of incinerated liver, is seen in the nuclei of the parenchyma cells. The chromatin, as Findlay recorded, responds to the action of the virus by becoming marginated, in which case incineration renders the nucleoplasm conspicuous. The nucleolus appears to have become more refractile, and together with the inorganic remains of the peripherally marginated chromatin frequently shows a faint yellowish coloration. This colour value, which is by no means constant, is often detected in the chromatin of the infected tissue at this period after inoculation.

As Findlay (1933) has already described the general cytology of the intranuclear inclusions of liver cells in animals infected with Rift Valley fever, it will be unnecessary to describe them in detail. Nevertheless, for the sake of comparison it will be convenient to review briefly their appearance as seen in stained preparations. The inclusions can best be studied before necrosis has become general (from 24 to 30 hours after inoculation) ; they can be detected in about 85 p.c. of liver cells. When viewed under an oil-immersion objective they form polymorphic bodies, frequently filling the nucleoplasm, with the exception of a variable marginal zone, and when large they may be indented by the punctate masses of peripheral chromatin (*see*

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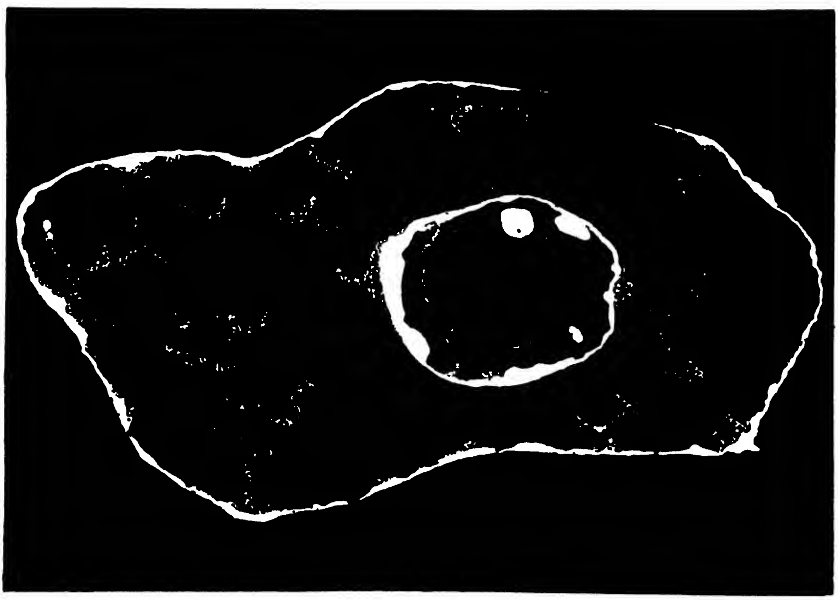

6.

fig. 5). The nucleoplasm of the corresponding incinerated sections of liver studied under the same magnifications contains several ash deposits formed from chromatin, one formed from the nucleolus and a faint linear residue of inorganic material, which represents the marginal limits of the inclusion body (*see* fig. 6). Beyond such feebly concentrated ash no further residue results from the incineration of the inclusion.

The thin line of mineral salts representing the peripheral zone of the inclusion is composed of a white residue, and can be optically differentiated from the highly refractive inorganic material forming the nucleolus.

The next phase of the fever is that from 48 to 55 hours after inoculation, when the liver necrosis has become general. Both the inorganic picture and the stained preparation of necrotic areas obtained at this period show marked contrast with those obtained 24 hours after injection of the virus (*see* figs. 2 and 4).

The distribution of the mineral salts during advanced Rift Valley fever necrosis is depicted in fig. 4, which reveals the inorganic structure of the necrotic areas of liver. In the hepatic lobules the cells composing them have lost their normal structure and the inorganic salts within them have become disorganized in arrangement. An appreciable increase in calcium salts, which have become localized in a diffuse manner throughout the cytoplasm of the degenerating cell (*see* fig. 4), is evident.

In most cases the ash at the peripheral regions of the cell has become clumped, and, if the nucleus has not broken down, it is generally represented by a thick, irregular wall of ash. These clumps of highly refractile ash are clearly seen in the accompanying photomicrograph (fig. 4) and form a characteristic feature of this condition.

Examination of an intact nucleus with an oil-immersion objective shows that the small marginal mineral residue of the incinerated intranuclear inclusion has not been increased during advanced necrosis, and, moreover, that it cannot be observed with certainty in the nucleoplasm if the nuclear membrane has broken down.

In a previous communication Findlay has pointed out that the general necrosis of the liver produced in mice by the virus of Rift Valley fever is comparable in rate to that produced by the action of certain chemical poisons and is different from that produced by other infections. It became of interest to compare the necrosis of Rift Valley fever with that experimentally produced in the livers of rodents by intraperitoneal injections of carbon tetrachloride.

Marked differences were detected in regard to the localization and appearance of the mineral salts of the liver cells when acute necrosis was induced by the action of this poison, which results in the death of the animal within 48 hours, as compared with the findings after a similar period in mice moribund with Rift Valley fever. Incinerated preparations of livers with carbon-tetrachloride-induced necrosis showed that the mineral structure of the protoplasm consisted of a network of finely divided inor-

ganic salts, which did not possess the highly refractive quality so character istic of the virus-injured tissues. There was also an absence of the aggregation of the calcium salts into clumps. The curious difference between these two types of liver necrosis in regard to the appearance and distribution of the mineral oxides is clearly illustrated in photomicrographs 3 and 4.

Discussion.

Although chemical tests have thrown little light on the composition of the inclusion bodies in general, few authors have availed themselves of the technique of microincineration as a new means of approach for determining their inorganic structure. Rift Valley fever in the mouse was selected for this study because the liver responds to the action of the virus in the form of an acute necrosis resulting, as a rule, in death within 48 hours of inoculation, and unlike most virus diseases the acidophilic intranuclear inclusions are restricted solely to the parenchyma cells of the liver.

It has been found that the few types of inclusion bodies so far examined by the technique of microincineration yield a characteristic mineral residue which is specific for that type of inclusion.

Covell and Danks (1932) reported an abundant compact inorganic residue in the cytoplasmic inclusions of rabies, and Cowdry (1933) in studying the intranuclear inclusions produced by the yellow fever virus observed that on incineration they yield little or no ash. The Borrel bodies of fowl-pox, on the other hand, were found by Danks (1932) to leave an abundant characteristic inorganic structure composed largely of calcium, from which he concluded that the relatively large deposits of inorganic material in them probably serve as a locus for the adsorption of the virus. Rector and Rector (1933), using the same technique, have recently demonstrated that the ash of the herpetic intranuclear inclusions from the cerebral cortex of rabbits varies according to the age of the inclusion body, the maturer inclusions containing appreciably less residue than the younger.

The fact that an inorganic ash is left after incineration of these inclusion bodies is new evidence in favour of the view that these structures are not artefacts, as has been suggested. Whether the inorganic material, as detected by microincineration, represents the actual distribution obtaining in the living condition is problematical. Judging by the inorganic picture presented by such highly organized inclusions, as those of fowl-pox, described by Danks (1932), where the location of the minute particles of mineral ash corresponds topographically both in size and in position with that part of the inclusion which shows a selective action for the stain, it would appear that the error, if any, is slight.

The optical differentiation between the mineral residues representing the chromatin the nucleolus and the inclusion body observed in this investigation is of interest. The tinge of yellow, indicative of ferric oxide, sometimes seen in the chromatin and more frequently in the nucleolus, but never in

the inclusion body, confirms the previous observations of Cowdry (1933) on the microincineration of intranuclear inclusions of yellow fever in the livers of monkeys. He concludes " that it may represent iron as indicated by the application of the Bensley-MacCallum test," which has been used to demonstrate the presence of iron in these structures and its absence in the intranuclear inclusions. Cowdry further points out that this method of mineral differentiation by incineration between the nucleolus and the inclusion body may help to settle the status of those inclusion bodies which it is suggested are of nucleolar origin.

The linear residue of inorganic material representing the marginal limits of the intranuclear inclusions seen in the liver cells 24 hours after inoculation with Rift Valley fever is similar to some of those which are typical of the more mature intranuclear inclusions of herpes simplex, as illustrated by Rector and Rector (1933).

No diminution of the ash, however, was observed in the inclusion body of Rift Valley fever, such as these authors record in the herpetic inclusions, as being associated with varying degrees of development. Moreover, no visible increase in the ash content of the inclusion body was ever detected during acute liver necrosis, though this was shown to be associated with a marked increase and clumping of the calcium salts in the cytoplasm.

The fact that there is similar increase of inorganic material in the cytoplasm in the liver necrosis induced experimentally by means of intraperitoneal injections of CCl_4 suggests that the mineral increase in Rift Valley fever necrosis is a phenomenon usually associated with necrosis in general and is not due to the discharge of the inclusion body into the cytoplasm by disruption of the degenerate nuclear membrane.

Increases also in the amount of calcium salts have previously been recorded by means of microincineration by Scott and Horning (1933) in necrotic areas of malignant tissues. These compare favourably in coarseness and in the aggregations of the ash, with those detected in Rift Valley fever necrosis. In addition, the characteristic net-like structure formed by increased inorganic material in the carbon tetrachloride liver necrosis is similar to the peculiar ash formation recently described by Patton (1933) in the degenerating anterior horn cells in experimental poliomyelitis.

Summary.

1. The technique of microincineration provides additional evidence of the nature of virus inclusion bodies.

2. The inorganic structure of the intranuclear inclusions caused by the Rift Valley fever virus as revealed by the incineration of infected liver sections is described in detail.

3. A differentiation has been demonstrated between the ash resulting from incineration of chromatin, nucleolus, and inclusion body.

4. The discrete nature of the residue after incineration of the inclusion

body yields further evidence that the inclusion body is neither an artefact nor a simple pathological derivative of normal nuclear structures.

5. The ash distribution resulting from the liver necrosis produced by the virus of Rift Valley fever is compared with the inorganic residue of liver in which necrosis has been induced experimentally by carbon tetrachloride poisoning.

6. The process of necrosis in malignancy, in carbon tetrachloride poisoning, and in several types of virus infection results in a disorganization of the inorganic components of the tissues which is very similar in all cases. The liberation of the inclusion body from the disrupted nucleus does not appear to influence the incineration picture in the case of infection due to Rift Valley fever virus.

DESCRIPTION OF PLATES.

The figures of plates I and II are all photo-micrographs of incinerated tissues taken by dark-field illumination.

Fig. 1.—Shows the inorganic structure of normal mouse liver. Observe the distribution of the ash clearly indicating the cell wall, nuclear membrane, and chromatin.

Fig. 2.—Shows the cellular ash of mouse liver 24 hours after inoculation with Rift Valley fever virus. Compare with fig. 1.

Fig. 3.—Incinerated mouse liver 48 hours after injection of carbon tetrachloride. Compare with fig. 1, and note disorganization of inorganic components, together with increase of cytoplasmic ash.

Fig. 4.—Shows liver necrosis in mouse liver 48 hours after inoculation with the virus of Rift Valley fever. Compare this with necrosis induced by carbon tetrachloride poisoning in fig. 3. Observe appreciable increase in ash, and the coarse aggregation of calcium salts in the degenerating liver cells. An intralobular vein, together with incinerated blood elements, is seen in the centre of the field. The endothelial cells are conspicuous for their concentrations of salts.

Figures 5 and 6 are camera lucida drawings of a stained and incinerated liver cell 24 hours after inoculation with Rift Valley fever virus.

Fig. 5.—Shows control stained cell as seen in transmitted light. Note the curious marginated chromatin, the structure of the intranuclear inclusion, and the general condition of the cytoplasm.

Fig. 6.—The same, as revealed after incineration and viewed in dark-field illumination. The peripheral chromatin leaves a heavy ash, and the intranuclear inclusion is represented by a finely marginated inorganic residue.

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535.822.8. III.—A METHOD OF ELIMINATING LENS-FLARE FROM GAUSS AND VERTICAL ILLUMINATORS.

By E. E. Jelley, B.Sc., A.I.C., F.R.M.S.

(*Read December* 20th, 1933.)

Three Text-Figures.

The Fedorow universal stage, in addition to its well-known applications to optical crystallography, provides a convenient three-circle goniometer for

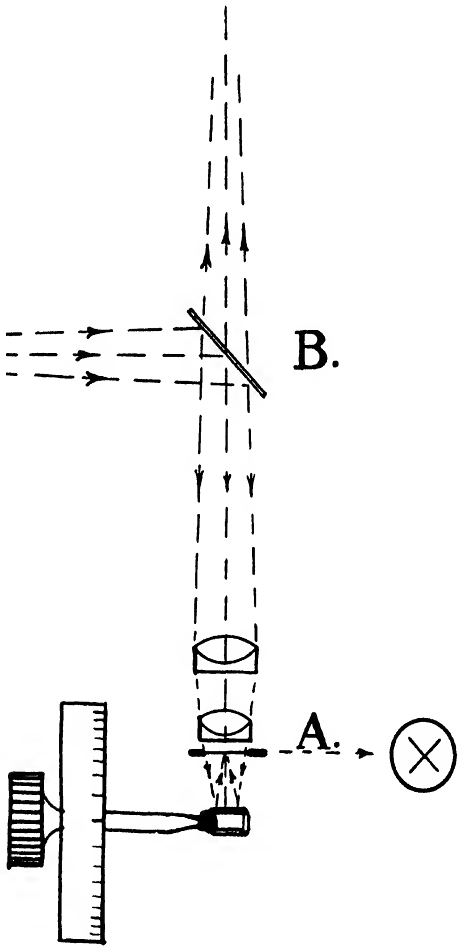

Fig. 1.

measuring the interfacial angles of very small crystals. Two methods of illumination have been used for this purpose: the "illuminated face"

method of Brögger, and the method devised by Fedorow. In Brögger's method the crystal is illuminated by a parallel beam of light, and the setting is made so that the illumination in the microscope eyepiece is a maximum. This method is not very precise, and suffers from the disadvantage that the possible amount of rotation of the crystal on the different axes is reduced by an amount somewhat greater than the angle between the direction of the beam and the axis of the microscope. In Fedorow's method (fig. 1), a glass disc " A " having a black cross marked on it is placed in front of the microscope objective, and light is reflected down the microscope body-tube by means of a Gauss reflector " B." When the crystal has been adjusted on a special holder which replaces the glass segments of the universal stage, with a face perpendicular to the microscope axis, it is first brought into focus by suitably lowering the objective, and then the objective is further lowered until the black cross is brought into focus by reflection from the crystal face. With small crystals, however, the black cross is often invisible because far more light is reflected from the glass surfaces of the objective than from the crystal.

Obviously the reflected light from the objective can be cut down to a negligible amount by plane-polarizing the light which is reflected down the microscope body-tube and placing an analyser over the eyepiece in the extinction position. It is only necessary, therefore, to modify the light reflected from the crystal face so that it will be transmitted by the analyser. This end is achieved in a very simple manner by placing a suitable thickness of a birefringent substance, such as mica, in the diagonal position between the objective and the crystal (fig. 2).

In this arrangement it is essential that the vibration-plane of the polarizer (i.e. the plane of the electric vector) be at right-angles to the microscope axis in order that the maximum amount of plane-polarized light shall be reflected. The illuminating efficiency of this arrangement is high, as is shown by the following considerations.

In fig. 3 let the incident beam I, which has its electric vibration in a horizontal plane, have unit intensity. The intensity of the reflected beam R is

$$\frac{\sin^2(45^\circ-r)}{\sin^2(45^\circ+r)},$$

where r is the angle of refraction.

If the glass reflector has a refractive index of 1·52, $r=27{\cdot}7^\circ$, and the intensity of R is 0·097 or 9·7 p.c. The back face also reflects this percentage of the light which falls on it, so that R′ is 8·6 p.c., and the total light reflected downwards is 17·3 p.c. If the polarizer is rotated through a right angle the intensity of the reflected light falls to 1·9 p.c.; in intermediate positions of the polarizer the reflected light is elliptically polarized, and cannot be completely extinguished by the analyser.

The intensity of light transmitted by a birefringent plate in the diagonal

position between crossed nicols depends on the phase retardation according to the equation

$$I=I_0 \sin^2\left(\pi\frac{\Gamma}{\lambda}\right),$$

where λ is the wave-length of the light, and Γ is the path difference caused by the birefringent plate, which is numerically equal to the difference in

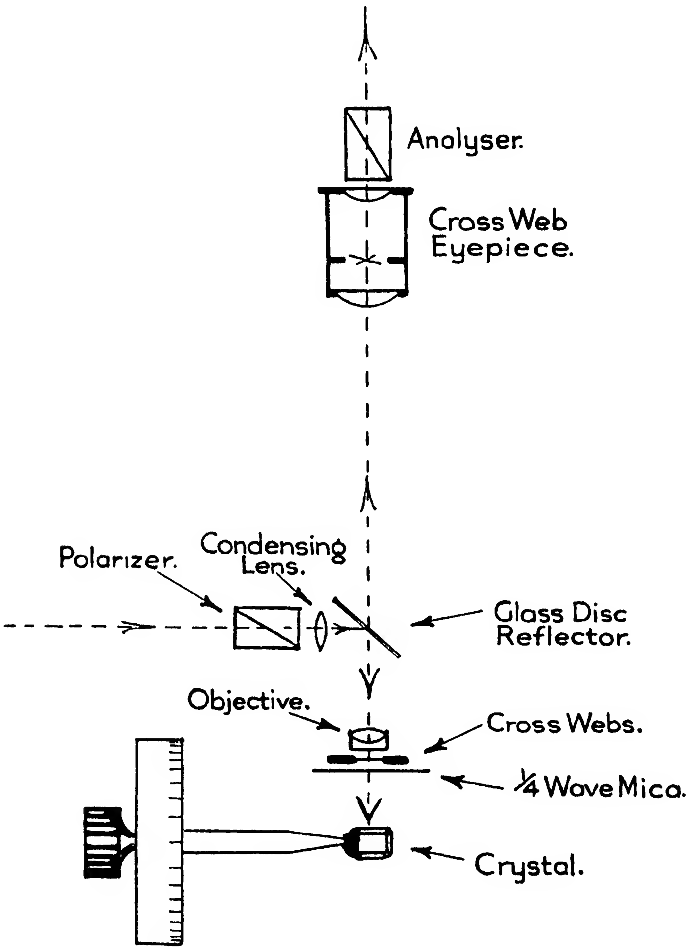

Fig. 2.

refractive indices multiplied by the thickness of the plate. In the present arrangement the light passes twice through the birefringent plate, so that Γ in the above equation must be taken to mean the path difference of the double thickness. If a " quarter-wave " mica plate is used, the total phase retardation is a half-wave, so that $I=I_0$, a result which is only strictly true for one wave-length. The percentage transmissions of different wave-lengths

of light which have passed twice through a sheet of mica of quarter-wave retardation at $\lambda = 550 m\mu$ are as follows :

λ in $m\mu$ . . .	400	450	500	550	600	650	700
Percentage transmission	69	88	97	100	98	94	89

When this arrangement is illuminated with white light, the light transmitted by the eyepiece analyser has a slight yellowish tinge. If for any reason it is desired to have white light transmitted, a thick birefringent

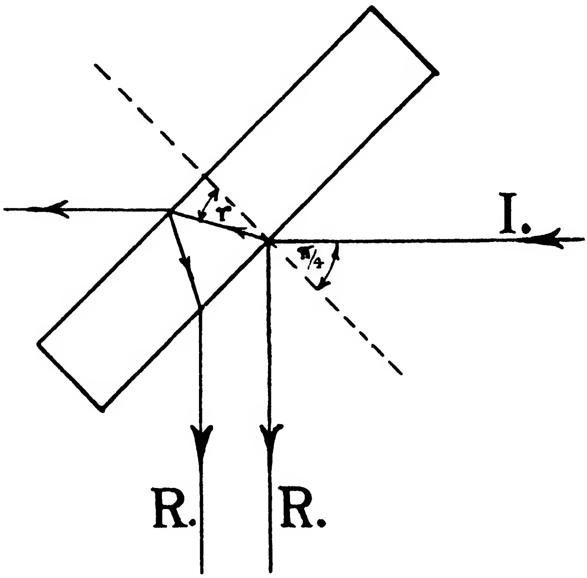

FIG. 3.

plate is used which gives white of a high order between crossed nicols, but the transmission falls to 50 p.c.

The overall transmission, neglecting reflection losses on the upward path of the light, is 9·6 p.c. for a simple Gauss reflector used with ordinary light, about 8 p.c. with crossed nicols and a quarter-wave plate, and about 4 p.c. with crossed nicols and a plate of high birefringence. It will be noticed that the illumination given by the proposed arrangement is as high as 83 p.c. of that given in the absence of polarizer and analyser.

It is suggested that the quarter-wave plate be cemented to Fedorow's cross-line plate so that the cross-lines correspond with the vibration directions.

Application to Vertical Illuminators, with Special Reference to Ore Microscopes.

The present method of overcoming lens-flare has been tried with prism and cover-glass reflectors in conjunction with objectives from the lowest

powers up to a 2-mm. oil-immersion objective of 1·37 N.A. With high-power objectives the illumination efficiency is slightly reduced if the quarter-wave plate is not cut parallel to the plane of its optical axes. Thus in the case of mica, light travelling along directions corresponding to the isogyres of the biaxial directions-image is extinguished by the analyser. Nevertheless, the illumination in practice is quite good, and opaque objects, even of low reflecting power, show up very well without any of that "mistiness" which is caused by lens-flare. With oil-immersion objectives it was found sufficient to insert a very thin flake of mica in the immersion oil between objective and object. With lower powers a cover-slip bearing a quarter-wave plate of mica was oiled to the front lens of the objective. Ordinary long-mounted objectives may be used with a cover-glass reflector fitted with the present arrangement, but it is usually necessary to use short mounted objectives if a prism illuminator (such as that supplied complete with polarizer by Messrs. R. and J. Beck) is used, or the field of view may be slightly masked by the edge of the prism.

With 16 mm. and other low-power objectives the ore-microscopic technique recently described by Dr. Jones in a paper to this Society may be combined to advantage with the present method. To do this a quarter-wave plate of mica or gypsum should be arranged to slide or swing in front of the objective in the diagonal position. When this plate is in position the ore is seen by vertical incident light; on sliding the plate out of position the special interference effects of anisotropic absorbing crystals become visible.

IV.—NOTE ON THE INTRODUCTION OF THE FIELD LENS IN THE MICROSCOPE; DR. HENRY POWER AND HIS LETTERS.

By Reginald S. Clay, F.R.M.S., and Thomas H. Court.

Two Plates.

T. H. Court has recently discovered among the manuscripts at the British Museum the manuscript of Dr. Power's "Microscopical Observations," together with copies of correspondence with Richard Reeves (or Reeve), the optician (Sloan Collection, 1393), which throw important light on the early history of the microscope.

Until this discovery we had supposed that Monconys had been the first to have a microscope with a field lens. In our paper on the Hooke Microscope (*J. Roy. Micr. Soc.*, 1924, Vol. **44**, p. 358) we refer to Monconys' microscope, which in his "Voyages" (1665, Vol. I, p. 117, note) is said to have been made for him by the son-in-law of Viselius in 1660, and which was furnished with a field lens (*loc. cit.*, p. 128). Fabri ("Synopsis Optica," 1667) said it had been made to Monconys' order and design at Augsburg.

Among the manuscripts in the Sloan Collection [Sl. 1326, f. 31–32], however, is the copy in Power's own hand of a letter he had sent to Reeves in August, 1662, in which Power says: "May it not advantage the fabric of the Microscope if the eyeglass and middle glass were made to change their distances as well as the middle and object glass does." The letter also says that Power had seen such a microscope belonging to a Sir Robert Benlowe. Evidently Reeves was fitting all his microscopes with a field lens before the date of this letter, and therefore probably before Monconys had his made for him. In view of its importance, a facsimile of this letter is appended to this note.

Henry Power, "Dr. of Physick," as he calls himself on the title-page of his book, was born in 1623, and he entered Christ College, Cambridge, as a pensioner on December 15th, 1641; he graduated in 1644. In 1655 he obtained his medical doctorate. He practised for a time in Halifax, but he eventually settled at New Hall near Elland. He was elected a Fellow of the Royal Society on July 1st, 1663, he and Sir Justinian Isham being the first elected members of that body. He made no great name, as he made no important discoveries, and he only published the one book, the "Experimental Philosophy." He died at New Hall on December 23rd, 1668. He was buried at All Saints, Wakefield, and there is a brass plate to his memory

on the floor in the middle chancel which has a Latin inscription. His wife survived him.

The manuscript of the "Microscopical Observations" is dated 1661, while the other two parts—the "Mercurial" and the "Magnetical"—are dated 1659. The whole was published in 1664 as one volume, entitled "Experimental Philosophy in Three Books, containing New Experiments, Microscopical, Mercurial, Magnetical."

With the manuscript of the book is a description of the microscope which Power used. This is not contained in the printed work, and as it is the earliest detailed description of a compound microscope of which we know, it is reprinted in Appendix I. From this description it does not appear that his microscope actually had the improvements for which he asked in his letter of August, 1662, for the field lens does not seem to be separable from the eye lens; also it seemingly had only one objective, or he would surely have spoken of the choice of the one most suitable for a given observation. The microscope had a body covered with leather, and a draw tube. The focusing was effected by screwing the body up and down through a collar fixed at the top of a tripod, the slide being placed on the base of the tripod. It could be used either for opaque or for transparent objects.

In Appendix II we have printed two letters from Reeves to Power, one giving the prices of his telescopes and microscopes—he made telescopes up to 30 feet in length—and also the letter of Power to Reeves above mentioned. In considering the prices of his microscopes and telescopes given in Reeves' letter, it must be remembered that a pound was at that time worth several times as much as at the present time—perhaps six times as much.

Although Power published only the one book, there are a number of essays (apparently unpublished) among the manuscripts; these are: "Experiments and Subtilities" (1334); "Observations on the Comet which appeared in 1664" (1326); "Experiments with the Air Pump" (1326); "Additional Notes to the Microscopical Observations" (4022); "Experiments recommended to Dr. Power by the Royal Society" (1326); "A Course of Chemistry" (496); a number of poems—mostly on botanical subjects (4026); "Some Objections against Astrology" (1326).

APPENDIX I.

Power's Description of His Microscope.

This Microscope consists of three glasses

1 The object glass
2 The middle glass
3 The eye glass

1. The object glass is a little glass & is in that small brass houell which you may take of and on at the end of the long brass screw.

2. The middle glass is that faire round convex glass which is placed in the middle of the tube with a brass ring about the edge of it which is to keep it fast in its place for shogging or falling out.

3. The eye glass is that which is placed towards the top of the tube & is a little double convex glass (about the bigness of a shilling). It is called the eye glass because it is nearest the eye when you looke through the microscope at any object.

About these glasses you must observe that you keep them from any oyl or grease touching them (which will stain & spot their clearness & diaphinity you must wipe them with a cleane handkerchief from any dust or misty vapour that soyle them, & remember to keep the microscope in a dry place, else the dampy moysture will spoyl them. It is not much matter wheather side of the glass be layd upwards, when you have dried them and put them nih the tube againe.

The tube in which all these glasses are placed consists all of 3 parts.

The top screw or Head-screw of 2 parts.

The Body of 2 parts (an inward & outward cylinder.

The foot-screw or Pedistall.

1. The top screw is the short screw to which the eye is placed which being taken of, the eyeglass appears. The second pair of it being taken of the middle glass appears, which is fastened to a cylinder that moves up and down in the body which by drawing up & down (when you look through the Microscope) will greaten or lessen the object as you please.

2. The body is the outmost leather cylinder to the bottom of which is fastened the brass screw with the houell screw, the object glass is put on the end of it.

3. Lastly the pedistall or foot screw is the part which hath 3 brass Leggs & screws of or on from the brass screw or higher or lower as you please. In the bottom of this pedistall is a round hole which is covered with the object plate which is that black piece of wood that moves every way & with the midle of which is let in that small round piece of ivory so that you may the object either upon the white ivory or the black Cedar as shall be seen better for some objects appeare better upon a dark ground & some upon a white.

If the brass screw be to glad you may rubb it with a bit of beeswax & that will harden it at any time. Thus much for the description of the microscope.

The use of the Microscope.

1st. Having wiped the Glass clean & set them in their due places & Having screwed all the parts of the Microscope together lay the object on the object-plate (suppose a little sand then laying the eye close to the top of the tube looke through the tube moving the screw higher or lower till you find the object at the best distance to be seene, then you may draw up the inward cylinder out of the Body higher or lower as you please which will greaten or lessen the object as you please.

Note 1st. That you will see nothing considerably well but in a clear light.

I sometimes use with a burning glass to strike a full light upon the object plate where the object lies & so can see it most lively.

2nd. That you can but see little small animalls the best & clearest because this glass will but take in a very little object at once. I need say noe more, only I have sent this little Box of such things I looke often at, & I know will . . . * Can rectifye your mistakes in any thing

Your Servant H. Power

* A few words cannot be made out.

APPENDIX II.

Copies of Letters between Reeves and Power.

1. A copy of Mr. Reeves letter.

Sir,

I have received y^r letter inclosed in y^r Book & Powers in wch you resolved to adventure on ye glass of 12 foote erected & inverted with convexes wch according to y^r command I have sent with directions how to use it pasted to ye several parts of ye tube ye round piece y^t ye inverting glasses are in is written within ye drawer as well as on ye outside. Ye purpose of them is to observe ye planets. If you would see them without rays you must use an aperture y^t does not lett in too much light, but when you will see ye Pliades or ye milky way then ye biggest aperture is to be used. When you observe ye Sunn you must look through a dark and coloured glass (of wch sort I have here enclosed & sent you two wch may be held next ye eye to keepe ye sun's Beams from offending it.

And to give you an Account how much a Microscope of 6′ will magnify is a Hard matter but as near as I can guesse it magnifies a mite to ye appearing bigness of a mouse, a mite out of ye magnifying glass is no bigger than then a sand & how many grains of sand a box so bigg can hold can hardly be numbred Sir I would not willingly faile of observing y^r desires in any thing in my power & will return you ye best relation I can describe of ye objects wch shall appeare to ye veiwes of my friends & mine owne sight here on ye neere Eclipse & will ever remaine

Affectionate to serve you
Richard Reeve.

April ye 6
(1661)

Mr. Richard Reeves our famous glass grinder. His letter to me about my Telescope (11th March 1660).

Sir,

According to your brothers request who was lately with me I shall give you an account of Telescopes which I conceive are fittest to your intent

for the observation of the Eclipse of the sun by Mercury. The longest glasses are the best in regard they enlarge the object most & so discover the more minute parts of it more particularly. But Galilaus that he observed with one made with a concave glass next the eye & a convex glass next the object which because if the tube be of much length thay take in but a little compass & are not therefore so useful in observing the heavenly bodies as those more lately invented which are now made with 3 or 4 convexes.

A concave because these sorts of telescopes (as is demonstrated by reason & confirmed by experience) will take in 40 times more of an object than the other. I have here endorsed & sent you for your satisfaction all the prices of my glasses both microscopes & telescopes & shall be glad to serve you with any you please to write for assuring you that they shall be as good & well wrought as any England can afford. Sir I presume there will be some coming & going with observations of this strange Eclipse to be made at my house several men of Art in town determining to meet there that day to the same purpose, what observations they make I shall (if you desire it) send you an account of, & shall in Lieu thereof beg the like favour of you. Sir no more at present but that I desire to be your servant to my power

Richard Reeve.

11th March (1660)

Telescopes with Concaves

2 inches	0–10–0
3 ,,	0–10–0
6 ,,	0–10–0
1 foote	0–10–0
2 ,,	0–15–0
3 ,,	1–0–0
4 ,,	2–0–0

Telescopes with convexes incerted & erected.

2 foote	4–0–0
3 ,,	5–0–0
4 ,,	6–0–0
5 ,,	8–0–0
6 ,,	10–0–0
9 ,,	12–0–0
12 ,,	15–0–0
24 ,,	20–0–0
36 ,,	30–0–0

Microscopes of several sizes.

3–0–0
4–0–0
5–0–0
6–0–0

A copy of Dr. Power's letter sent to Mr. Reeves.

Sir

I intended long since to be your chapman for a Microscope & would very gladly have one as good as you can make it. I have past many of your making & found none comperable to that you sold Sir Robert Benlowe though in all of them there are some deficiencyes which I heartily wish your further skill & experience could rectifye, as first :

1. that the Microscope takes in so very little of the object (if distinctly seene that nothing but minute things can well be discerned therein.

2. the object glass stands so very neare the object plate that many things cannot be layd thereon for observation unless the brass screw be of very great height.

3. why may it not advantage the fabric of the Microscope if the eyeglass and middle glass were made to change their distances, as well as the middle and object glass does.

4. I would have a Chrystall object plate that some Bodyes might be seene cleerely through, which the opacity of the object plate now hinders.

5. I would have severall sorts of object glasses because I thinke some may more distinctly represent some sort of objects than others.

6. why may not 2 convexes serve the Microscope & be as powerful to represent as 3.—

If you have or can any way advantage the fabric of the Microscope by these small hints I pray you let me know & what be the price of an exceeding good one. And I shall employ my Brother Mr. Thomas Power the bearer hereof to deale with you for one.

Mr. Townley has promised mee to send you the measure of my eyeglasses for my telescope (for he has it at present) I pray you send down an eyeglass fitt for it.

If you would do me the favour as to find mee an eyeglass or 2 of different proportions I could make some use of them with my lesser telescope which you know draws about 5½. I returne you many thankes for the reflecting plates you fitted to both my tubes I am much pleased with them Thus desiring to hear from you I take leave and rest

Your very loveing Friend
H. Power.

Hallifax this 10 August (1662)

I pray you lett mee know if you have any easy way of observing the Maculae Solis for I could never yet discover them fully.

H. Power.

A Coppy of Dr Powers letter sent to Mr Reeves.

Sir

I intended long since to be yr Chapman for a Microscope & would very gladly have one, as good as you can make it I have perused many of yr making, & find none comparable to ye you sould Sir Robert Bindlos's, though in all of them there are some deficiencyes wch I heartily wish yr further skill & experience could rectifye as first:

1 That ye Microscope takes in so very little of ye object (if distinctly seene) yt nothing but minute things can well bee discerned therein.

2 Ye object glass stands so very neare ye object plate yt many things cannot be layd thereon for observation, unless ye Brass screws be of a very great length.

3 why may it not advantage ye Microscope, if ye eye-glass & middle glass were made to change their distances, as well as ye middle & object glass dos!

4 I would have a chrystall object plate yt some bodyes might be seene cleerely through, wch ye plaine tyn of ye object plate now hinders.

5 I would have severall sorts of object glasses, because I thinke some may more distinctly represent some sort of objects then others.

6 why may not 2 convexes serve ye Microscope, & be as powerfull to represent as 3. —

If you have or can any way advantage ye Philosophick little Microscope, by these small hints I pray you let mee know & what will be ye price of an excellent good one.

And I shall employ my Brother Mr Thomas Power yr [illegible] here to deale with you for one.

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Mr Towneley has promised mee, to send you ye measure of my eye-glasse for my Tellescope, for hee hath ye measure. I pray you send downe an eye glasse fitt for it.
If you would doe mee the favour, also send mee an eye glasse or 2 of different ~~qualityes~~ proportion? I could make some use of them with my lesser Tellescope wch you know drawes about 5 1/2 feet. I re-turne you many thankes for the reflecting plates you fitted to my tubes I am much pleased with them. Thus desiring to heare from you I take leave & rest.

Yr very Loving friend
H. Power

Hallifax this
10 August (1662)

I pray you lett mee know if you have any easy way of observing ye Maculae solis for I could never yet discover them fully.

H Power

1 2 3 4 5 6 7 8 9 10
Sl. 1326 BRITISH MUSEUM P. 1098
1 2 3 4

V.—A METHOD OF SEALING WET PREPARATIONS. 578.6.

By J. E. Barnard, F.R.S., F.R.M.S., and F. V. Welch, F.R.M.S.

(*Read February 21st*, 1934.)

One Text-Figure.

The sealing of microscopical preparations in which the object is mounted in fluid has always been uncertain and is sometimes difficult. The apparatus to be described overcomes most of the difficulties and is easy and certain in use. Its necessity became evident in ultra-violet microscopy, particularly in the preparation of material containing virus bodies, which are always in a watery medium. The orthodox method is to make a thin preparation between slide and cover-glass and then to apply hot melted wax round the edges to prevent evaporation. Sometimes this was satisfactory, but frequently the seal was imperfect and the preparation did not last long enough to enable photographs to be secured. Further, for technical reasons that cannot be discussed here, it is essential that the wax shall be in an even layer and shall have no irregularities in thickness. These troubles have been entirely overcome by the method now described and the sealing of preparations can be effected in much less time than by any other means we have tried hitherto. The appliance may be described in reference to fig. 1. A is a metal tube about 6 inches in height and 2 inches in diameter, inside which a tubular carbon-filament electric lamp is mounted vertically. At the top of the metal tube is a shallow reservoir in which wax or any other suitable sealing material is placed. A thick brass disc, D, is mounted on the outside of the vertical tube, substantially as shown, so that it can be moved up and down the tube and clamped in any desired position. Around this disc are four or more holes, into which interchangeable fittings can be dropped. These are of the nature of dies and their upper edges are the size and shape of the cover-glasses it is required to seal. The tubes C are feeders; they are used to transfer a suitable quantity of the melted material from the reservoir to the edges of the dies. A resistance, E, is mounted on the baseboard in series with the carbon lamp in the main tube, and a control switch, F, allows the resistance to be cut out of the circuit if desired. The method of use remains to be described. A suitable quantity of wax or other sealing material is placed in the reservoir B; the heating lamp is switched on and allowed to run not only until the wax is melted but so that the whole of the disc D with its fittings is well above the melting-point of the wax. When this temperature is reached the resistance E is brought

into use by means of the switch F, and the heat of the lamp is thus reduced to that necessary to maintain the whole appliance at a suitable temperature. To seal a preparation the tube C is lifted from the reservoir and the melted wax remaining on its lower end is transferred to the upper edges of one of the die fittings on D. For most purposes one application of the feeder tube conveys enough material to the die edge to make an effective seal. The preparation to be sealed is then inverted and placed on the die tube so that

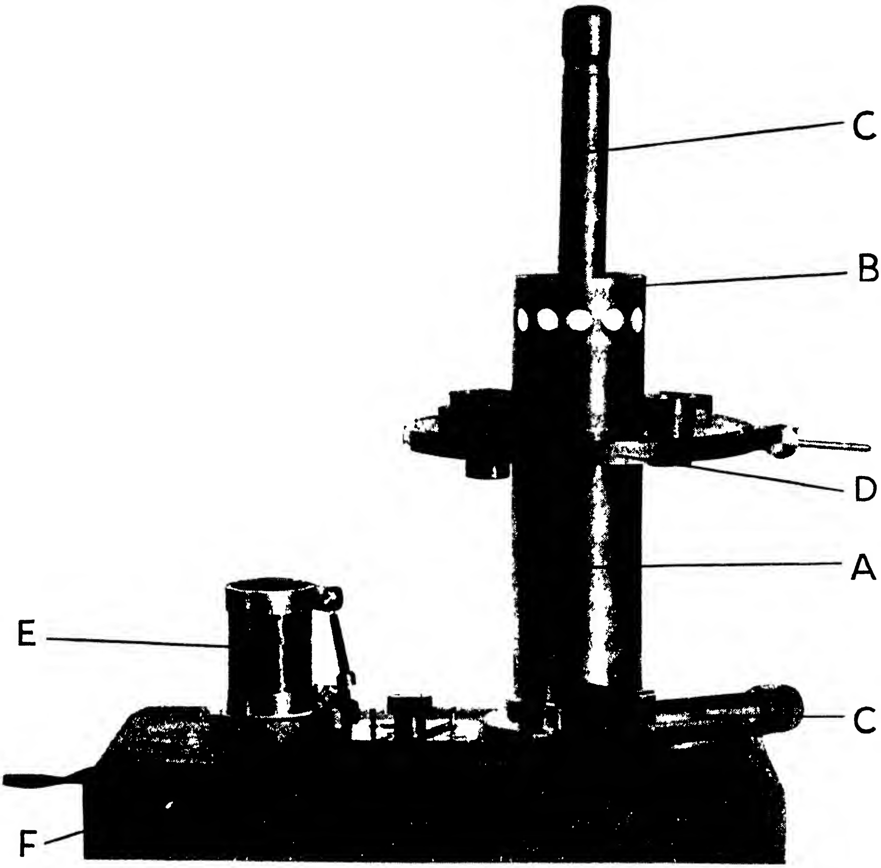


Fig. 1.

the melted wax spreads over the edge of the cover-glass and joins it to the slide. The preparation should lie on the die for some seconds, long enough to ensure that the wax and both glass surfaces at the point of contact are brought to about the same temperature. This point is important, as our experience shows that with clean, dry glass surfaces the efficiency of a seal depends on all the factors involved being brought to the same temperature. This does not damage the preparation: the heating is so localized and the

time so short that there is no risk of injury. It is possible to apply a second coating of sealing material, although this is rarely necessary. Our experience is mainly confined to the use of paraffin wax, but our experiments suggest that any other material, such as shellac-rosin mixture, can be used without difficulty. Dies of various sizes are used, but they are mainly round or square. For tissue culture work it is sometimes necessary to form two parallel wax bars on which a cover-glass can be inverted. This method is particularly suitable for this purpose, as two strips of wax of exactly the same width and thickness can be laid down with ease.

OBITUARY.

DUKINFIELD HENRY SCOTT.

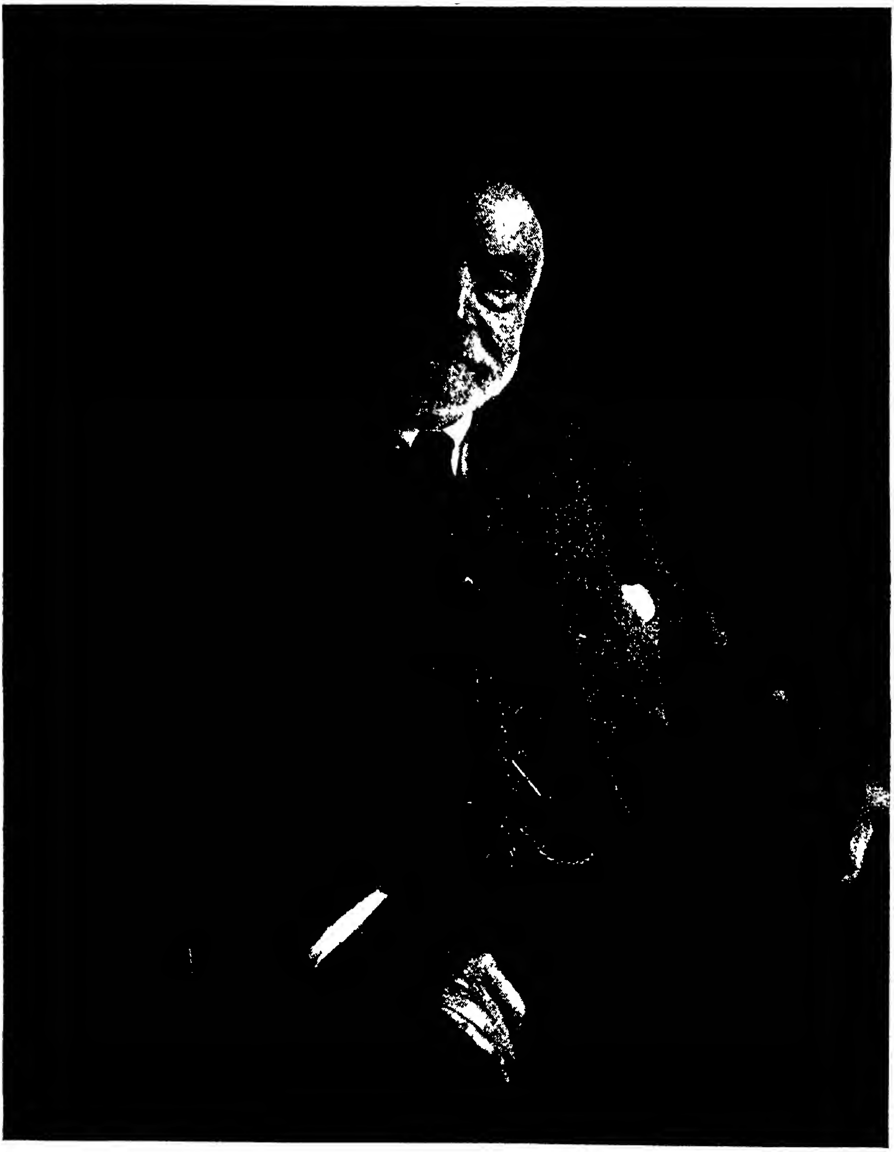
(1854–1934.)

By A. B. Rendle.

Dr. Scott was one of the senior members of our Society; he was elected in 1880 and from 1904 to 1906 was our President. He was born in London, November 28th, 1854, the son of Sir Gilbert Scott, R.A., the famous church architect and designer of the Albert Memorial in Kensington Gardens. His great-grandfather was the Rev. Thomas Scott, the commentator. I first met him in 1888 when I joined the Department of Botany at the Natural History Museum, and when he was in charge of the botany at the Royal College of Science near by as assistant-professor to Thomas Huxley. I have enjoyed his friendship uninterruptedly ever since. A few years ago he gave me some autobiographical notes to be used "when the time comes," and to these I am indebted for some of the facts in this memoir.

Scott was educated at home by tutors; he never went to school. He was a great reader, his first interest being history. But in his thirteenth year his mother (*née* Catherine Oldrid) interested him in field botany—she had learnt botany at school under the old Linnean system. Griffith and Henfrey's "Micrographic Dictionary" led him on to the study of structure, and before he was sixteen he had read Berkeley's "Cryptogamic Botany" and translations of several German works—Braun's "Rejuvenescence in Nature," the works of Mohl and Nägeli on the cell, and Hofmeister's classic work on the Higher Cryptogamia. He was always enthusiastic on his debt to those who made available to English readers the great works of the German botanists. Without any special training he was using the microscope. Freshwater algæ were his great joy, but he also studied seaweeds and some of the easier parasitic fungi.

From 1872 to 1876 he was at Christ Church, Oxford, where he read for "Honours Greats," and subsequently he spent three years as an engineering student. He did not regret the time spent on the classics nor his mechanical training. At the end of 1879 he began to think of returning to botany, at the suggestion and on the encouragement of certain friends, one of whom gave him an introduction to Sir Joseph Hooker, through whom he met Thiselton-Dyer. Dyer strongly advised him to go to Germany, and, after three months' hard work at the language, we find him, at the end of February,



Dr. Dukinfield H. Scott, F.R.S., F.R.M.S. 1854–1934.

Face p. 32.

1880, a student in Sachs's laboratory at Würzburg, with Goebel as assistant to the professor. Scott has given a delightful account of his time at Würzburg in his "German Reminiscences of the Early 'Eighties," published in the *New Phytologist*, March, 1925. He worked there continuously until July, 1881, when he passed the examination for the Ph.D. *summâ cum laude*. His thesis was on the development of articulated laticiferous vessels. Scott's teaching career began in May, 1882, when he became assistant to Prof. Daniel Oliver at University College. Two years later he transferred to the Royal College of Science, South Kensington, nominally as assistant-professor to Huxley, with sole charge of the botanical teaching. He remained at the Royal College till 1892, when he became Honorary Keeper of the Jodrell Laboratory at Kew.

During these earlier years Scott's investigations followed on the lines initiated by his work under Sachs, and a number of papers on various subjects in plant anatomy appeared in the early numbers of the *Annals of Botany*, of which he subsequently (1912–21) became a joint editor. But in 1889 he met Prof. Williamson, whose work on the plants of the coal-measures was shedding new light on the structure and organization of the fossil Pteridophyta. A visit to Williamson at Manchester shortly afterwards roused his enthusiasm, and his own appointment at Kew, affording increased leisure and opportunity for research, coincided with his co-operation with Williamson, who on his retirement had come to live at Clapham. Williamson's cabinet of slides provided ample material for investigation, and new material was continually coming in. Three joint papers were published in the *Philosophical Transactions* of the Royal Society (1895, 6). After Williamson's death in 1895, Scott writes: "I set myself to continue his work and have endeavoured to do so ever since."

Williamson's collection was purchased by the Trustees of the British Museum, and by a special arrangement Scott, who had contributed to the cost, was allowed to borrow material for his work. In 1924 the Department of Geology at the Museum was further enriched by the purchase of Scott's collection, on which were based his own extensive contributions to palæobotany.

Scott remained at Kew till 1906: he regarded these fourteen years as the most productive of his life. In 1906 he bought a small estate at East Oakley, Hants, where, with the help of Mrs. Scott, also a keen botanist and gardener, he made a charming home and garden. He continued his palæobotanical work to the end of his life. The results are embodied in numerous papers in the *Annals of Botany*, the publications of the Royal and Linnean Societies, and other journals; also in the work of younger botanists whom he had trained or inspired.

Although he had retired from active teaching in 1892 Scott did not lose interest in London University botany. For some years he was a member of the Board of Studies; he also served for a period as Examiner, and gave occasional lectures or courses of lectures. The most productive of the latter

was a course at University College in 1896, which formed the basis of his classic text-book "Studies in Fossil Botany" (1900). A course at Aberystwyth in 1922 appeared as his "Extinct Plants and Problems of Evolution." A product of his active period of teaching was his "Introduction to Structural Botany" (1894 and 1896), an admirable elementary text-book which has served successive generations of students. He had an easy, attractive style of writing and was a master of exposition. Many of the illustrations in his text-books were by Mrs. Scott, of whom he writes: "My wife has been a great help to me in my work." Mrs. Scott died in January, 1929.

Scientific societies also claimed his interest. He was twice President of the Botany Section of the British Association, at Liverpool in 1896 and at Edinburgh in 1925, Botanical Secretary of the Linnean Society (1902–08), and President (1908–12). He also served as General Secretary of the British Association (1901–03) and Foreign Secretary of the Royal Society (1912–16); he had been elected F.R.S. in 1894. His presidential addresses often took the form of critical reviews of the position at the time of some aspect of botany and showed his wide interest in the science. Others deal with some special phase of his own subject, such as his addresses to our own Society: "What were the Carboniferous Ferns?" (1905), "The Life and Work of Bernard Renault" (1906), and "Flowering Plants of the Mesozoic Age in the Light of Recent Discussion" (1907). But he was by no means content to remain a figure-head of a Society; at the ordinary meetings his contributions in debate and discussion were eminently helpful, especially at the Linnean Society, where he will be greatly missed. One remembers him, too, at the Annual Meetings of the South-Eastern Union of Scientific Societies; he was President of the Union in 1909. To be remembered also was his help and encouragement of younger workers, with whom he frequently collaborated. And many botanists both at home and from abroad have pleasant recollections of the hospitality of his charming home at East Oakley.

Recognition of his work was world-wide and found expression in awards and honorary membership of many societies. These included the Royal and Darwin Medals of the Royal Society, the Linnean Society's Gold Medal, and the Wollaston Medal of the Geological Society. Of Societies he writes: "I most value the honour of being a Correspondent of the French Académie des Sciences." Blessed with health and leisure to follow his own bent, he leaves behind him the record of a long and useful life. A worthy successor to his old tutor Williamson, he will be remembered as the founder of the modern British School of Palæobotany. He was active to the last, attended the meeting of the Linnean Society on January 4, and presided, as the senior member, at the subsequent meeting of the Society's dining club, after which he drove back to his home in Hampshire. He died at his home after a short illness on January 29. Four daughters survive him (three are married); his only surviving son was killed in the Great War.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(*Under the direction of* G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

Specific Staining of Pigments and Prepigments with Aniline Dyes.—R. VON VOLKMANN ("Über elektive Darstellung des Abnutzungspigmente und seiner Vorstufen mittels Anilinfarben," *Ztschr. f. Wiss. Mikr.*, 1933, **49**, 457–60). Prepigment and small scattered masses of pigment are difficult to demonstrate. Any of the usual fixatives, with the exception of those containing osmic acid, may be used. Stain for from 5 to 15 minutes in Gram's aniline gentian violet and rinse in tap water. Differentiate for from 15 to 30 minutes in 80 p.c. alcohol, then pass through 95 p.c. and absolute alcohol, xylol and mount. The pigments vary in tint from deep to light violet. For liver pigments stain in neutral red, rinse, transfer to gentian violet for from 2 to 5 minutes, and differentiate in alcohol. For mounting "Cædax" of the I. G. Farben Industrie is recommended as it does not decolorise neutral red. G. M. F.

A Substitute for Alcohol in Dehydrating Microscopic Preparations Mounted in Balsam.—R. VON VOLKMANN ("Die Vermeidung von Alkohol beim Einschluss mikroskopischer Präparate in Balsam," *Ztschr. f. Wiss. Mikr.*, 1933. **49**, 456–7). Terpineol, since it lacks the destaining action of alcohol, can be used as a dehydrating agent for sections between water and xylol. As much water as possible is removed by wiping them; they are then transferred to terpineol, agitated, and transferred to fresh terpineol. The slides are then wiped and transferred to xylol. Terpineol is harmless to most stains, with the exception of neutral red. After this stain the slides should not remain long in terpineol.
G. M. F.

Chromic Fixation in Alcoholic Media.—H. C. WATERMAN ("Preliminary Notes on Chromic Fixation in Alcoholic Media," *Stain Technol.*, 1934, **9**, 23–31). There are difficulties in the way of combining chromic fixation with the more rapid penetration obtained in an alcoholic medium. Chromium trioxide does not form a stable solution in either methyl or ethyl alcohol, but quickly oxidizes an equivalent amount of alcohol. Certain salts of the (violet) hexa-aquo-chromic ion $[Cr(H_2O)_6]^{+++}$ can be readily prepared in an alcoholic solution by the following method. A stock solution is made from finely powdered potassium chrome alum, 5 gm.; potassium acetate, 4 gm.; distilled water, 5 c.c. The chrome alum must be the violet salt and not a greenish compound. The components are ground to a thin smooth paste in a small glass mortar, which is then covered with waxed paper to prevent evaporation and allowed to stand for several hours. To the deep

violet solution thus formed there is added 95 p.c. methyl alcohol, 53 c.c. The alcohol is added a few cubic centimetres at a time. The stock solution keeps for from one to three months. Osmic acid cannot be used in alcoholic solution, but its addition to aqueous chromic reagents presents many advantages. Volatile toxic oxidants which do not attack alcohol are iodine and possibly the quinones. Various strengths of iodine and acetic acid in the alcoholic chromium medium described were tested and in certain respects were preferable to Bouin's fixative.

G. M. F.

A New Method of Vital Coloration.—W. SEMENOFF ("Nouvelle méthode de coloration vitale," *Bull d'Histol. appl.*, 1933, **10**, 129–30). To 10 c.c. of a basic stain solution (methylene blue, toluidine blue, or thionine) add 1–2 c.c. of N/10 HCl and 2–3 c.c. of N/10 $Na_2S_2O_3$; add water to bring the mixture up to 100 c.c. The leucobases prepared are transparent and resistant to atmospheric oxygen, but must be protected from alkali and sunlight. A drop of the solution is placed on the object and the preparation is studied under the microscope. Protozoa and nuclei are diffusely stained. If a cover-glass is applied there appears, beside general staining, differentiation due to reduction by the protoplast. If the leucobase is prepared with a polychrome stain such as thionine or toluidine blue, a vital polychrome staining is obtained: nuclei appear dark blue, cytoplasm violet to crimson, while protoplasmic inclusions show various tones.

G. M. F.

The Staining of Embryo Nervous Tissue in Bulk with Silver.—H A. DAVENPORT, W. F. WINDLE, and R. H. BEECH ("Block Staining of Nervous Tissue with Silver," *Stain Technol.*, 1934, **9**, 5–10). For the nerve tissues of 12–20 mm. long embryos of cat, rat, pig, and chick the following techniques were found most satisfactory. A. *Bielschowsky Method:* Fix for 2 days in an aqueous mixture of 4 p.c formaldehyde and 0·5 p c. trichloracetic acid; wash about 1 hour and transfer to a mixture of equal parts of water and pyridine; soak in this mixture for a day or two and wash for from 2 to 4 hours according to the size of the embryo. Impregnate in 1–1·5 p.c $AgNO_3$ for 3 days at 37° C. or 5 days at room temperature and wash 12 mm. embryos for 20 minutes or 20 mm. embryos for 1 hour—intermediate sizes in proportion. Impregnate in an ammoniated silver solution prepared by adding 5 c.c. of concentrated ammonia water to 40 c.c. of 2 p.c. sodium hydroxide solution, mixing well and running in with shaking enough 8·5 p.c. silver nitrate solution to render the solution slightly opalescent. Allow small specimens to remain in the solution for 6 hours; wash for 15 minutes. Reduce with 0·4 p.c. formaldehyde for the same time as was allowed for the ammoniated silver impregnation. B. *Cajal Method*. Fix for 2 days in 2 p c. ammoniated alcohol. Transfer to 5 p.c. aqueous pyridine solution for 24 hours, then wash for from 1 to 3 hours. Impregnate for 2 or 3 days at 37° C. in 1·5 p.c. $AgNO_3$. Wash for from 20 minutes to 1 hour according to the size of the embryo. Reduce for 4 hours in 4 p.c. pyrogallol solution. If preparations are too light the time in the pyridine solution and subsequent washings may be reduced to about one-sixth the time stated.

G. M. F.

The Mechanism of Marchi's Staining Method.—R. L. SWANK and H. A. DAVENPORT ("Marchi's Staining Method: Studies of some of the Underlying Mechanisms Involved," *Stain Technol.*, 1934, **9**, 11–20, 1 pl.). Spinal cord of rat and rabbit were stained, after experimental lesions, by variations of Marchi's method. The presence of an oxidizing agent ($K_2Cr_2O_7$, $NaIO_3$, or $KClO_3$) in the osmic acid solution is of primary importance and a preliminary oxidation in

Müller's fluid is unnecessary or even detrimental. Acetic acid added to Marchi's fluid accentuates the action of the oxidizing agent in restraining the staining of normal myelin. Too high a concentration of oxidizing agent or of acid may inhibit staining of degenerate myelin. Marchi's and Busch's methods have been modified as follows: Fix 1 day in 10 p.c. formalin and transfer without washing to the staining mixture, either A or B. Staining mixture A consists of Marchi's fluid with from 1 to 3 p.c. of glacial acetic acid, B an aqueous solution containing $KClO_3$ 0·25 p.c., osmic acid 0·33 p.c., and acetic acid 1 p.c. Stain for about 1 week. These methods are specially suitable for spinal cord and medulla, but are not satisfactory for brain. The detrimental effects of long post-mortem autolysis or of prolonged fixation in formalin may be counteracted to some degree by increasing the concentration of the acid in Marchi's fluid up to 5 p.c., or of the $KClO_3$ up to 0·4 p.c. in the modified Busch's fluid. G. M. F.

The Demonstration of Oligoglia in Nerve Ganglia: The Importance of Fixation in the Ice Chest and of Mordanting in Hydrofluoric Acid.—I. Bertrand and J. Guillain ("Technique de recherche de l'oligoglie ganglionnaire. Importance d'une fixation à la glacière et d'un mordançage à l'acide fluorhydrique," *Compt. rend. Soc. de Biol.*, 1934, **115**, 706-7). The following technique has been used for demonstrating oligoglia in the spinal and sympathetic ganglia of cats and horse. The tissues removed immediately after death are placed in the following solution: ammonium bromide 10 gm, commercial formalin 70 c.c., distilled water 430 c.c., to which immediately before use 20 drops of pyridine are added for every 100 c.c of the mixture. The tissues in the fixative are immediately put in the ice chest at a constant temperature of 4°–5° C. The fixative is renewed at the end of 24 hours, fixation being continued for from 3 to 7 days. After washing for 10 minutes in distilled water four sections are cut from 12μ to 15μ thick. The sections are left in pure pyride for from 12 to 24 hours, then transferred directly to chemically pure hydrofluoric acid (2 drops per 40 c.c. of distilled water). The sections are kept for 1 hour at a temperature of 37° C., then washed several times in distilled water. The sections are next placed for 4 hours in a 5 p.c. solution of sodium carbonate and are then passed directly into the following solution: Silver nitrate 10 p c. aqueous solution, 5 c.c.; sodium carbonate 5 p.c. aqueous solution, 20 c.c.; enough ammonia to dissolve the precipitate, distilled water up to 75 c.c. Reduction is carried out in 1 or 5 p.c. formalin; after washing, the sections are immersed in an 0·2 p c solution of gold chloride, washed and fixed in a 5 p.c. solution of sodium hyposulphite, again washed, dehydrated, cleared, and mounted in canada balsam. G. M. F.

The Staining of Neuroglia.—F. Proescher ("Contribution to the Staining of Neuroglia," *Stain Technol*, 1934, **9**, 33-8). The chemistry of Wiegert's glia staining method is critically discussed. An investigation of the Heidelberger Victoria blue staining method has shown that Victoria blue may be replaced by other phenylmethane dyes as methyl violet, ethyl violet, and crystal violet, saturated aqueous solutions being employed. Frozen sections are placed in distilled water, though if not stained at once they may be kept in 10 p.c. formalin for not more than 24 hours. The sections are immersed for from 14 to 24 hours in a saturated solution of Victoria blue B (Grübler). The solution need not be filtered but only carefully decanted from the undissolved stain. The stained sections are rapidly washed in distilled water, mounted on slides with albumin-glycerine, blotted with filter paper, and dried in the air. The dried sections are then exposed to the ultra-violet rays for 30 minutes and are afterwards immersed for a few

seconds in N/20 iodine solution, or the iodine solution may be floated directly on the sections. The iodine is at once removed, the sections blotted with filter paper, dried for 10 minutes in the air, differentiated in xylol-aniline, and finally washed thoroughly in xylol The sections are cleared in oil of cloves, the oil is removed with xylol, and the sections are mounted in balsam. G. M. F.

Two Methods of Staining Guarnieri Bodies.—M. Kaiser and M. Gherardini ("Ueber zwei Methoden zur Kontrastfarbung der Guarnierikorperchen," *Zentralbl. f. Bakt.*, 1934, **131**, Orig., 128, pl. 1). The two methods are as follows:—(1) Phloxine, water blue method (stains obtained from Hollborn, Leipzig). Tissues are fixed in sublimate alcohol. After section and removal of paraffin the sections are washed for from 1 to 3 hours in distilled water. They are then placed for one minute in a mixture of a 2 p.c. aqueous solution of phloxine and a 2 p.c. aqueous solution of water blue in a proportion of 1 to 3 Rinse in distilled water, pass through the alcohols and mount in cedar oil or in "Cædax." The inclusions stain ruby red, the cytoplasm of the cornea epithelium violet blue, the nucleus dark blue and the stroma of the cornea pale blue. (2) Nukplaskoll method. Sections after washing in distilled water were for 30 minutes placed in a 2 p.c. aqueous solution of Nukplaskoll, rinsed in distilled water, quickly passed through 96 p.c. alcohol and then into absolute alcohol. The inclusions are purple red, the nucleus deep violet, the cytoplasm and connective tissue green.
G. M. F.

Demonstration of Vitamin C.—G. Bourne ("The Staining of Vitamin C in the Adrenal Glands," *Austral. J. Exp. Biol. and Med. Sci.*, 1933, **11**, 261, 4 text-figs.). About 3–5 gm. of pure paraformaldehyde are placed in the bottom of a large test-tube. The tissue is suspended in a small piece of cheese-cloth in a cradle within an inch of the paraformaldehyde. The tube is then heated gently till the paraformaldehyde begins to decompose. The tissue is left in the vapour for from 10 to 15 minutes after the paraformaldehyde has all dissolved After fixation the tissues are washed for a few seconds in distilled water and then dropped into an aqueous solution of silver nitrate for about 12 hours Sections of tissues impregnated with silver nitrate are treated with gold chloride and photographic hypo as in the Da Fano Golgi technique. Granules, which are thought to be those of vitamin C, are found in the cells of both the medulla and cortex of suprarenals.
G. M. F.

The Staining of Spermatozoa.—W. H. Cary and R. S Hotchkiss ("Semen Appraisal: A Differential Stain that Advances the Study of Cell Morphology," *J. Amer. Med. Assn.*, 1934, **102**, 587–90, 5 text-figs). Smears are made on thin cover-slips and are fixed in Schaudinn's solution for 1 minute. They are then placed in 50 p.c. alcohol for 30 seconds and in 3 oz. of distilled water containing 2 drops of tincture of iodine for the same time. Washed in tap water, they are immersed for 30 seconds in a 5 p.c. aqueous solution of eosin, then in 50 p.c. alcohol faintly acidified with hydrochloric acid for 1 minute. Washed in distilled water and immersed in hæmatoxylin for 2½ minutes, then for 1 minute in 3 oz. of distilled water containing 2 drops of acetic acid. Washed in distilled water, dried and mounted. All portions of the spermatozoon are adequately demonstrated by this method. G. M. F.

Celloidin Sections in Bulk.—C. S. Hallpike ("A New Method of Handling Celloidin Sections in Bulk," *J. Path. and Bact.*, 1934, **38**, 247–8, 2 pls.). In dealing with serial sections two problems have to be dealt with: (*a*) the numbering and

ordering of each section, the greater number of the sections being stored for future reference; (*b*) the arrangement and handling of one or more "tracer" series (every 5th or 10th section) for immediate staining and mounting in order. (A) In numbering sections for storage the most convenient way is the transference of each section, as cut, to a numbered slip of paper. These are arranged in bundles and stored in 50 p.c. alcohol. (B) In handling a tracer series the following technique is employed. The tracer series (every 5th section) is transferred directly by a brush from the knife to a bottle with an ordinary glass stopper at one end through which it may be partially filled with shot or mercury, and at the other end a blind neck with a fused-in glass stopper. A glass dish of suitable size is provided with notches at opposite sides. In this the bottle is laid horizontally, rotating in the notches, the lower half of the bottle being immersed in 70 p.c. alcohol contained in the dish. Round the bottle are placed a number of rubber rings. The process of applying sections starts at the top and proceeds counter-clockwise. Beneath the rubber band is retained a small, light glass hook, with this the band is raised and the section slipped beneath it so that just the upper edge is engaged. The elastic is lowered upon the section by moving the hook to the right in preparation for the next section. At the end of the first tier a gap is left and the process continued in the second tier In this way the whole surface of the bottle is covered with sections firmly attached and arranged in series. The sections are kept moist by occasionally rotating the bottle which is half immersed in 70 p c. alcohol. For staining, the bottle weighted by mercury is carried, now standing upright, through all the various staining, differentiating, and dehydrating solutions *en masse*. After immersion in carbol xylol the sections are transferred to prepared and marked slides. G. M. F.

X-ray Control of Decalcification.—C. S. Hallpike ("X-ray Control of Decalcification in the Histology of Bone," *J. Path. and Bact.*, 1934, **38**, 249–50, 1 pl.). Seen by X-rays the centripetal action of the acid in dense bone such as the femur or the temporal bone can be traced in a very clear manner. In less compact bone the picture is more irregular. G. M. F.

The Staining of Paschen Bodies in the Cells of the Cornea.—E. I Turewitsch ("Beobachtungen ueber die Paschenkörperchen im Hornhautepithel," *Zentrabl. f. Bakt.*, I. Abt, Orig., 1933, **129**, 381–9, 7 figs). Sections are placed for from 20 to 25 minutes in a 2·5 p c. solution of ferrous ammonium alum. They are washed for from 10 to 15 minutes in tap water and then placed for 10 minutes in a 5 p.c. aqueous solution of tannin. They are again washed in tap water and stained overnight in a solution of azure I (Hellborn) 1 in 5000 or 1 in 10,000. After rinsing with water they are placed for from 10 to 15 minutes in a saturated aqueous solution of picric acid which differentiates the sections in from 30 to 90 minutes. After thorough washing the sections are dried between filter papers, dehydrated, and mounted in balsam. G. M. F.

Cytology.

Microincineration of Degenerating Nerve Cells in Anterior Poliomyelitis.—W. E. Patton ("Microincineration of Degenerating Anterior Horn Cells in Experimental Poliomyelitis," *Proc. Soc. Exp. Biol. and Med.*, 1933, **31**, 195–7). During the early stages of degeneration the cells become somewhat swollen, the Nissl bodies are lost, and the cytoplasm tends to stain lightly. The nucleus is often enlarged and may occupy an excentric position in the cell body. The basophilic chromatin appears bead-like or as irregular masses scattered about

within the nucleus or plastered to the nuclear membrane, while it is in such cells that nuclear inclusions may be seen. Incineration shows that these cells contain rather less mineral matter than the normal neurone. The Nissl substance does not appear, while the inclusion bodies leave a very slight ash. In more severely injured cells the cytoplasm becomes filled with basophilic granules. The incinerated preparation gives a dense white, refractile granular cytoplasmic ash, but the nucleus leaves a very light ash. G. M. F.

Centrioles in Amphibian Cells.—A. W. POLLISTER ("Notes on the Centrioles of Amphibian Tissue Cells," *Biol. Bull.*, 1933, **65**, 528–45, 6 pls.). The centrioles have been studied in the cells of a 14 mm. larva of *Ambystoma opacum*. It is concluded that the centrioles are minute self-perpetuating bodies characterized by somewhat specific staining reactions, but more by their specific location in each type of cell and by their behaviour. Their functions are twofold. They have the capacity of acting as blepharoplasts at the bases of motile cell processes—flagella or cilia. And in the prophase of mitotic cell-division they assume positions that determine the orientation of the spindle, an event that is the initial visible indication of the bipolarity that foreshadows division into two daughter-cells.
G. M. F.

Tissue Cultures of Helix aspera.—J. BRONTE GATENBY and J. C. HILL ("Improved Technique for Non-aseptic Tissue Culture of *Helix aspera* with Notes on Molluscan Cytology," *Quart. J. Micr. Soc.*, 1934, **76**, 331–52, 4 pls., 3 text-figs.). By keeping pieces of mantle cavity wall in Hédon Fleig saline it is possible to make tissue cultures which grow out for about 5 days, after which time bacteria have increased so enormously that growth is checked though the cultures will live for several weeks if kept in a suspended condition. The main type of cell which grows out is an amœboid element, identical apparently with the general connective elements of the normal tissue of the snail. Neutral red either stains, is segregated, or is deposited in the various categories of cells in various ways. In spermatocytes it appears almost always inside the Golgi apparatus, thus forming with the dictyosomes a "zône de Golgi" of Parat. In the pulmonary epithelial cells the neutral red at once stains the preformed granules which are visible in unstained living cells. These granules are not directly related to the Golgi bodies. In amœbocytes the neutral red appears principally as large segregated globules anywhere in the cytoplasm. Finally, it enters with great difficulty into the epithelial cells of the mantle. The only homologous bodies in the cytoplasm of the various categories of cells are the Golgi bodies and mitochondria. In no case was a mitotic figure found in any Helix culture, though cells suggesting amitosis were found most commonly when the cultures were growing out fastest. G. M. F.

Amœbocytes of Ostrea.—S. TAKATSUKI ("On the Nature and Functions of the Amœbocytes of *Ostrea edulis*," *Quart. J. Micr. Soc.*, 1934, **76**, 379–431, 12 text-figs.). There are granular and hyaline amœbocytes in the blood of the oyster. The amœboid movements of the granular amœbocytes are slow: the granules, which are yellow or yellowish-green in the fresh condition, are neutrophil with a tendency to become stained by the basic dyes intravitam. In fixed and stained amœbocytes granules cannot be distinguished. The amœbocytes are distributed throughout the body, an especially large number being present round the gut. The amœbocytes become entangled with one another by bristle-like pseudopodia or by elongated strands of hyaline ectoplasm outside the body. There is no true coagulation of the blood and no fibrin production. G. M. F.

Localization of Vitamin C in the Suprarenal Cortex.—A. GIROUD and C. P. LEBLOND ("Localisation histochimique de la vitamine C dans le cortex-surrénal," *Compt. rend. Soc. de Biol.*, 1934, **115**, 705–6). Using the reduction of silver nitrate as an indicator of the presence of ascorbic acid, vitamin C is found to be present in the suprarenal cortex in the zona fascilurans and zona reticularis, but not in the zona glomerulosa. The granules of vitamin C are found only in the cytoplasm, never in the nuclei. They are quite distinct from the lipoid globules, but may impregnate the mitochondria as well as the cytoplasm. G. M. F.

Arthropoda.

Hydracarina.

Atractides Species from Hungary.—LADISLAUS SZALAY ("Über zwei Wassermilbenarten aus der Gattung Atractides C. L. Koch," *Zool. Anz.*, 1933, **102**, 227–36, 10 text-figs.). Specimens obtained from two different Hungarian localities, and which, while bearing a certain resemblance to one another yet exhibited a difference in the epimeral and genital areas, are referred by Szalay to *Atractides* (*Rusetria*) *spinirostris* Sig. Thor. The differences are explained as stages in development prior to maturity. With these in mind, Szalay proceeds to discuss other species of the genus and gives expression to the opinion that certain later specific names may, in the end, have to be referred back as synonyms to *spinirostris*. It is suggested that Thor's redescription (in German) was based on more mature material than that used for the earlier description (in Norwegian), though Thor gives as his reason for the later description the likelihood of some one not knowing or mistranslating Norwegian. Turning to the typical generic forms, we have two new species, *Atractides* (*Atractides*) *barsicus* and *A.* (*A.*) *dudichi* ("Zwei neue Wassermilben aus der Gattung *Atractides* C. L. Koch," *loc. cit.*, 1933, **103**, 171–6, 8 text-figs.), followed by a third, *A.* (*A.*) *longirostris*, and the hitherto undescribed female of *A.* (*Rusetria*) *ungeri* ("Eine neue Hydracarine aus der Gattung *Atractides* C. L. Koch und das Weibchen von *Atractides* (*R.*) *ungeri* Szalay," *loc. cit.*, 1933, **104**, 201–5, 6 text-figs.). BM/HNDH

Eylais degenerata and its related forms.—LADISLAUS SZALAY ("Eine neue Hydracarinen-Form aus der Gattung *Eylais* Latr. nebst Bemerkungen über *Eylais degenerata* Koenike und über ihre verwandten Formen," *Zool. Anz.*, 1933, **104**, 324–34, 13 text-figs.). As will be gathered from the title, a new variety, *Eylais megalostoma* var. *telmatobia*, is described from Hungary. Author then proceeds to discuss *Eylais degenerata* and the forms which in his opinion are allied to it. He conjectures that the capitulum (*Maxillarorgan*) is of a simpler and more primitive type than is to be found in other members of the genus, and he proposes to embrace these allied forms together in a subgenus which he names *Protoeylais*. Eight forms are installed by him in the new subgenus, while a number of other names are reduced to the status of synonyms to these eight. As further investigation proceeds, it is not beyond the bounds of possibility that other specific names may be reduced to synonyms, since the genus as at present recognized is noteworthy not only for the variety of forms existing within the genus but also for the irregularity which even a single specimen can display. BM/HNDH

Water Mites from Bukarest.—C. MOTAS (Jassy) and E. DOBREANU (Bucarest) ("Faune hydracarienne de quelques lacs des environs de Bucarest," *Academia Română*, memoriile secţiunii ştiinţifice, 1933, ser. iii, tomul ix, mem. 7, 1–19, figs. 1–10). Authors record twenty species of hydracarids found in three

lakes in the neighbourhood of Bukarest. *Hydrachna cruenta* and *H. schneideri* as well as *Georgella helvetica*, *Piona coccinea stjordalensis*, and *Arrhenurus denticulatus* are discussed in some detail, the salient points being figured. Accompanying the list of mite captures at each lake, is a note of the fauna and flora encountered.

BM/HNDH

Protozoa.

New Ciliate—Parasite of Monkey.—R. Hegner and C. Rees ("*Taliaferria clarki*, a New Genus and Species of Ciliate from the Cecum of the Red Spider Monkey, *Ateles geoffroyi* Kuhl," *Trans. Amer. Micr. Soc*, 1933, **52**, 317, 1 pl.). Description of a new ciliate from the cæcum of a monkey, *Ateles geoffroyi*, obtained in Panama. The parasite is named *Taliafferia clarki* gen n., sp n, belonging to the Holotrichous suborder Gymnostomina, allied to the family Nicollelidæ. This organism is characterized as follows: body ovate, measuring 83·2–145·6μ × 44·2μ × 83·2μ (average 108·86 × 61·63μ); peristome, cytostome, and cytopharynx subterminal; ectoplasm thick, consisting of two layers; cilia very numerous, single contractile vacuole near middle of the body; cytopyge subterminal, connected by canal with rectal vacuole; macronucleus oval with micronucleus closely applied to one end of it

C. A. H.

Gregarines from Oligochætes.—R. A Troisi ("Studies on the Acephaline Gregarines (Protozoa, Sporozoa) of some Oligochæte Annelids," *Trans. Amer. Micr. Soc.*, 1933, **52**, 326, 1 text-fig., 8 pls.). A study of five species of acephaline gregarines (including three new ones) from the seminal vesicles of American oligochæte worms of European origin The material was fixed in a modification of Schaudinn's fluid (containing 5–10 p c. glacial acetic acid) and stained with Mayer's hæmalum In *Rhynchocystis pilosa*, found in *Lumbricus terrestris*, *L. castaneus*, and *Helodrilus fœtidus*, the trophic stages are extracellular; its adult trophozoites undergo plasmotomy, the posterior portion of the body being cast off and the anterior nucleated one becoming the "precystic" organism; two of the latter (and not two whole trophozoites) become attached "head to head" and encyst *R. porrecta* was obtained from *Lumbricus rubellus* and *Helodrilus fœtidus*; its trophic stages occur in the lumen of the seminal vesicles, it also undergoes plasmotomy before encystation, but the casting off takes place in a number of parts. *Zygocystis wenrichi* sp.n. parasitizes both the last-named worms; it is the largest species of the genus, attaining a length of over 1 mm., the parasites frequently forming "head to head" syzygies; no plasmotomy occurs, two entire organisms encysting. On the completion of sporulation two residual bodies of cytoplasm are left at either pole of the cyst. *Apolocystis gigantea* sp.n. occurs in the same two hosts, it is spherical, with a diameter from 250μ to 800μ, its surface is covered with cuticular "hairs" and the endoplasm contains small paraglycogen granules. The cysts of this form are spherical and contain, on completion of sporulation, a central mass of residual cytoplasm, which is later dissolved. *A. minuta* sp.n., parasitic in *Lumbricus terrestris*, *L. castaneus*, and *L. rubellus*, is a small spherical organism, about 43μ in diameter, with cuticular "hairs."

C. A. H.

New Ectoparasitic Ciliate on Crustaceans.—Y. Miyashita ("Studies on a Freshwater Fœttingeriid ciliate, *Hyalospira caridinæ*, n.g., n.sp.," *Jap. J. Zool.*, 1933, **4**, 439, 15 text-figs.). Description of a Fœttingeriid ciliate (Holotrichida), *Hyalospira caridinæ* gen.n., sp.n, an ectoparasite in the moults of a freshwater Japanese shrimp, *Xiphocaridina compressa*. The new genus differs from the other

members of the subfamily Fœttingeriinæ in the ciliation, in the shape of the macronucleus, which is curved and band-shaped and dilated at both ends, and in the presence of a long accessory canal running from the contractile vacuole parallel to ciliary line 5. An account is given of the process of division and encystation of the ciliate, and of the various phases through which it passes in the course of its life-cycle, for which the nomenclature introduced by Chatton and Lwoff is employed.
C. A. H.

New Monocercomonas from a Lizard.—M. TANABE ("The Morphology and Division of *Monocercomonas lacertæ* n sp. from a Lizard," *Keijo J. Med.*, 1933, **4**, 367, 2 pls., 2 text-figs.). Description of *Monocercomonas lacertæ* n.sp. from the rectum of a Japanese lizard, *Erimias argus*. The flagellate measures 3·5–15μ $\times$ 2–8μ, it possesses a cytostome, the axostyle is composed of two fibres, and the proximal part of the trailing flagellum is attached to the body. During division the chromosomes are formed both from the karyosome and the chromatin granules between the latter and the nuclear membrane. The spindle arises from a centrosome. The axostyle disappears during the metaphase and new ones develop from the blepharoplasts during telophase. C. A. H.

Reproduction in the Foraminifera.—EARL H. MYERS ("Multiple Tests in the Foraminifera," *Proc. Nat. Acad. Sci.*, 1933, **19**, no. 10, 893–9, 1 pl., 2 text-figs.). The process of reproduction is described in three species, *Spirillina vivipara*, *Patellina corrugata*, and *Discorbis patelliformis*, both asexually and by plastogamic union. The paper is illustrated by some remarkable photographs of living specimens illustrating both processes Successive photographs at intervals of 3 days show (1) a specimen of *Spirillina vivipara* surrounded by an asexually produced group of twelve young shells; (2) six of these young shells have increased in size and formed themselves into three plastogamic pairs, each of which is surrounded by a brood of six young of the second generation. In *Patellina corrugata* the asexual reproduction closely parallels that described by Lister in *Polystomella*. When the asexually produced young attain about two-thirds the diameter of their parent, they may associate plastogamically with individuals of the same or different parents in groups of two or more. As many as nine individuals have been observed in a group. Individuals of different sizes may join in plastogamy, and one photograph shows a plastogamic group of one large and two small individuals of *Patellina*. This last observation is most important as it counters what has hitherto been the principal argument in support of the "budding" theory proposed by Brady (1884) and enlarged by Heron-Allen (1915), viz. the great discrepancy in size often seen in "associated pairs." Further observations are promised and will be awaited with interest by all concerned with the life-history of Foraminifera. A. E.

Foraminiferal Homonyms.—HANS E. THALMANN ("On Homonyms in Foraminifera," *Cont. Cush. Lab. For. Res*, 1933, no. 139, 96–8). The author states that he is preparing a continuation of Sherborn's "Index to Genera and Species of Foraminifera" which has been the standard work of reference since the dates of publication in 1893–6. He publishes a list of about fifty examples of homonymous names of species erected during the last thirty years, in order to attract the attention of the later authors to their errors, which should be corrected within about two years' interval after publication of this list. A. E.

Tertiary Orbitoids.—J. U. TODD and R. WRIGHT BARKER ("Tertiary Orbitoids from North-Western Peru," *Geol. Mag.*, 1932, **59**, no. 822, 529–43, pls. 39–41, 7 text-figs.). From material presented to the British Museum by the

Lobitos Oilfields, Ltd., the authors describe and figure seven species and varieties of *Discocyclina*, *Helicolepidina*, and *Lepidocyclina*. One species, *Discocyclina restinensis*, is new to science. The plates are good. A. E.

Pacific Foraminifera.—J. A. CUSHMAN ("Some New Recent Foraminifera from the Tropical Pacific," *Cont. Cush. Lab. For. Res.*, 1933, no. 137, 77–95, pls. 8–9, part of 10). Owing to conditions in America the Smithsonian Institution are delaying the publication of Part 3 of the author's monograph of Pacific Foraminifera. In order to secure priority of publication thirty-five new species and varieties are described and figured. Many of the new forms will be recognized as familiar by workers who have examined material from the Tropical Pacific. A. E.

Two New Species of Foraminifera.—J. A. CUSHMAN and A. C. ELLISOR ("Two New Texas Foraminifera," *Cont. Cush. Lab. For. Res.*, 1933, no. 138, 95–6, figs. on pl. 10). Describes and figures *Textularia smithvillensis*, said to be a characteristic fossil of the Claiborne Eocene (Weches formation) of Texas, and *Nonionella cockfieldensis* from the Cockfield formation of the same deposits. A. E.

South American Fusulinæ.—W. BERRY ("Fusulina from Peru and Bolivia," *Pan-Amer. Geologist*, 1933, **59**, 269–72, pl. 22). Abundant *Fusulinæ* were contained in a few rock specimens collected in 1919 from Carboniferous strata of Peru and Bolivia. Three species are represented and are now described ; two are stated to be new to science. They throw no light on the exact age of the deposits. A. E.

American Lepidocyclinæ.—T. WAYLAND VAUGHAN ("Studies of American Species of Foraminifera of the Genus Lepidocyclina," *Smithsonian Misc. Coll.*, 1933, Publication 3222, 1–53, 32 pls.). This profusely illustrated monograph is said to be designed with the view of aiding in the solution of problems of geological correlation in the Mexican Gulf and Caribbean region ; to assist in the identification of some species by publishing additional figures and descriptive notes ; and finally to consider the problems of variation in a few of the species. Six new species and two new varieties are published by the author in collaboration with W. Storrs Cole. The paper contains notes on the earlier literature of the genus, and much valuable information on the ranges of variation in a species, and on points of difference not regarded as due to variation. The plates, reproduced from photographs, are very good. A. E.

Distribution of Orbitoid Foraminifera.—T. WAYLAND VAUGHAN ("The Biogeographic Relations of the Orbitoid Foraminifera," *Proc. Nat. Acad. Sci.*, 1933, **19**, no. 10, 922–38, 7 tables). The Orbitoids range from Cretaceous to Miocene times and are found in Europe, Asia, Australasia, and both Americas. They were among the largest Foraminifera and in some regions their tests are the principal constituent of limestones. Their association with corals, of reef facies and such recent genera of Foraminifera as *Operculina*, *Heterostegina*, and *Carpenteria* is conclusive evidence that they lived in warm shallow water. To account for their wide distribution the author suggests that reproduction was by zoospores, and that the larvæ so produced were transported considerable distances by currents. Zoospores have been observed in many living species of Foraminifera, but of their subsequent life-history and vitality little is known as yet. In the case of corals the free-swimming larval stage has a duration up to 30 days, sufficient for its transport to a distance of several hundred miles. The present systems of surface currents and interoceanic connections between the Atlantic and Pacific during Cretaceous and Tertiary times are discussed in connection with the probable routes of migration of the Orbitoids, and the bearing which their distribution has on the problem of

former land areas in the Atlantic and Pacific basins. This is a paper exhibiting deep research and containing much information of vital importance in connection with the vexed problems of distribution which puzzle all students of Foraminifera.

A. E.

Ultramicroscopic Viruses.

Generalised Vaccinia in Man.—J. H. DIBLE and H. H. GLEAVE ("Histological and Experimental Observations upon Generalised Vaccinia in Man," *J. Path. and Bact.*, 1934, **38**, 29–38, 2 pls.). In a case of vaccinia which ended fatally as a result of a generalized vaccina the lesions in some respects resembled those occurring in small-pox though the vaccinial nature of the virus appears to have remained unchanged. The skin pocks appeared as primary epithelial lesions, the involvement of the corium being trivial by comparison with the epithelial changes. The visceral lesions, like the epidermal ones, were an almost pure necrosis without hæmorrhage and with only a minimum of reactive change. In the rabbit, after intravenous inoculation of vaccinia, visceral lesions are found in order of incidence in the lungs, liver, spleen, and suprarenals. In this case there were no lesions in the lungs or suprarenals. G. M. F.

Attempts to Produce Intranuclear Inclusions in vivo.—J. LEE ("Nuclear Changes following Intravenous Injection of Various Solutions," *Proc. Soc. Exp. Biol. and Med.*, 1933, **31**, 383–4). In an attempt to produce intranuclear inclusions simulating those caused by a number of viruses, cats under ether anæsthesia were injected through the femoral vein with glucose, sodium chloride, sodium bicarbonate, distilled water, or salyrgan. In addition, six cats were injected intramuscularly with salyrgan for 4 days. Nuclear changes were observed in all these cats, but not in those injected intravenously with the same substance. The nuclear changes were seen in the pancreas in six, in the kidneys in three, in the testes of two, and in the adrenals of two, but never in the central nervous system. The nuclear changes were very diverse: in some there was margination of basophilic chromatin on the nuclear membrane and the appearance of acidophilic bodies separated from the nuclear membrane by a halo. The nuclei were hypertrophied to a maximum of twice their normal diameter. Cytoplasmic degeneration, mitotic division, and regeneration of acini were also seen. G. M. F.

Inclusion Bodies in the Brains of Mice Infected with the Viruses of Vesicular Stomatitis and Equinine Encephalomyelitis.—P. K. OLITSKY, H. R. COX, and J. T. SYVERTON ("Comparative Studies on the Viruses of Vesicular Stomatitis and Equinine Encephalomyelitis," *J. Exp. Med.*, 1934, **59**, 159–71). After intracerebral inoculation of the viruses of vesicular stomatitis and equinine encephalomyelitis in white mice acidophilic material was present in the nuclei of most neurones. After intranasal inoculation, however, from one to three or four intranuclear bodies usually located in the nerve cells of the hippocampus and of the anterior gray matter of the cord. They are 1 or 2μ in diameter, acidophilic, regular in outline, flat, refractive and, while resembling in certain respects the inclusions from Borna's disease, there are definite differences from the latter. The bodies lie in sac-like nuclei which are somewhat swollen with a darkly stained basophilic membrane. They are often in juxtaposition to the nucleoli. The most effective stain for their demonstration is phloxine-methylene blue. G. M. F.

Rodents and Infection with Neurotropic Yellow Fever Virus.—G. M. FINDLAY ("The Infectivity of Neurotropic Yellow Fever Virus for Animals,"

J. Path. and Bact., 1934, **38**, 1–6, 1 pl.). The histological changes in the brains of guinea-pigs, field voles, and red squirrels infected with neurotropic yellow fever virus consist of perivascular infiltration with mononuclear cells, infiltration of the meningeal septa and varying degrees of degeneration in the ganglion cells. Rats, rabbits, and hamsters are non-susceptible. G. M. F.

The Origin of the Guarnieri Bodies.—P. F. MILOVIDOV (" Zur Frage nach dem Ursprung der Guarnierischen Korperchen," *Čas. lék. čes.*, 1933, 1060). Portions of cornea fixed in alcohol were sectioned and stained by the Feulgen reaction for thymus nucleic acid. The Guarnieri bodies gave a positive reaction and are therefore thought to be derived from the nucleus. G. M. F.

A New Virus Disease of Insects.—M. A. PAILLOT (" Un nouveau type de maladie à ultravirus chez les insectes," *Compt rend. Acad. Sc.*, 1934, **198**, 204–205). In the blood of a caterpillar of the species *Agrotis segetum* there were observed numerous small cocci 0·3 to 0 4μ in diameter, slightly larger than those seen in the blood of caterpillars of *Pieris brassicae* suffering from "pseudo-grassene." The minute bodies multiply only in the fat cells, passing into the blood stream at the destruction of these cells. Histological examination of the fat glands of the caterpillars reveals definite cytological changes. The nucleus loses its granular appearance and is transformed into a cresentic shaped mass. The cytoplasm is crowded with the parasitic bodies while the granular mitochondria show a tendency to agglutinate, giving rise to mulberry-like masses, which have a tendency to be localized at the periphery of the cells. Here and there in the fat gland are small cellular masses, not unlike tuberculous nodules, formed from modified cells. Attempts to infect healthy caterpillars by mouth or through the skin have been unsuccessful.

BOTANY.

(Under the direction of A. B. Rendle, D.Sc., F.R.S.)

GENERAL.

Cytology.

Asynaptic Maize.—G. W. Beadle. (" Further Studies of Asynaptic Maize," *Cytologia*, 1933, **4**, 269–87). Asynaptic plants are characterized by a general lack of pairing of chromosomes at first meiotic metaphase. The prophase stages of normal and asynaptic plants are described in detail. Initial synapsis occurs, apparently normally, in asynaptic plants, and is followed by abnormally early separation of paired homologues without the formation of chiasmata. Chiasma frequency is low at diplotene, diakinesis, and metaphase. The degree of metaphase pairing in asynaptic plants is variable. The number of bivalents varies from none to ten in the plants studied. Positive correlation exists between the number of bivalents at metaphase and the minimum number of chiasmata, which must be assumed to account for the observed associations. The observations support Darlington's hypothesis of post-diplotene association of homologous chromosomes by chiasmata. The spindle is much longer in asynaptic sporocytes which show no metaphase pairing of chromosomes than it is in normal sporocytes. This elongation may be related either to the lack of pairing or to the lack of orientation of chromosomes on the equatorial plate. Crossing over in asynaptic plants, measured in normal gametes ($n = 10$), is approximately normal. The asynaptic gene is located in the *P–br* chromosome approximately half-way between the *P* and *br* genes. J. S.

Cytology of the Malvaceæ.—J Hugh Davie (" Cytological Studies in the *Malvaceæ* and Certain Related Families," *J. Genetics*, 1933, **28**, 33–67). Seventeen new chromosome numbers are recorded for different species of ten Malvaceous genera. Morphologically the chromosomes show considerable uniformity. The numbers range from $2n = 14$ in *Lavatera trimestris* to $2n = 56$ in *Hibiscus africanus majus*. Association of several chromosomes into groups in a single metaphase plate indicates the possible polyploid nature of most of the genera observed These are considered to be derived from an ancestral type with a basic number of 7. No such association is seen in *L. trimestris*, which is considered a true diploid. In *Lavatera olbia* ($2n = 40$) and *Gossypium herbaceum* ($2n = 26$) the occurrence of a pair of chromosomes longer than any of the rest suggests that chromosome fusion in a normal hexaploid with forty-two and a normal tetraploid with twenty-eight chromosomes has given rise to a hypohexaploid and a hypotetraploid with $6n - 2$ and $4n - 2$ chromosomes respectively. The relative ages of the genera observed are estimated on the theory of secondary association of chromosomes in polyploids. A possible course of the evolution of the genus *Gossypium* is discussed. Definite evidence of an intranuclear spindle is seen in *Lavatera trimestris*. It is a compound structure, being an aggregate of components formed round each chromosome. Meiosis has been studied in certain genera. In these, multivalent associations may occur.

Chromosomes with interstitial chiasmata are more frequent than those with terminal, but are slower to separate at anaphase. J. S.

Prime Types in Datura.—A. D. Bergner, S. Satina, and A. F. Blakeslee ("Prime Types in *Datura*," *Proc Nat. Acad. Sci.*, 1933, **19**, 103–15). The term *prime type* is applied to races with modified chromosomes such as are produced by segmental interchange and simple translocation. The prime type races of *Datura* so far found in nature are due apparently to segmental interchange. The plants may or may not be morphologically distinct. Chromosome morphology and behaviour is described for these plants and an indication given of the value of prime types in the study of the genic constitution of chromosomes and of chromosomal evolution. J. S

Triploid Œnotheras.—José M. Capinpin ("Studies on the Genetics and Cytology of Triploid *Œnotheras*," *Cytologia*, 1933, **4**, 355–426). The materials covered by these studies are discussed under the following groups of triploid mutants: (*a*) 1928 *Œ. Lamarkiana rubricalyx* triploids, (*b*) 1929 triploids from pure *Œ. Lamarkiana*, and (*c*) triploids from other *Œnotheras* Experimental data are given concerning the origin of the triploids; cytological technique and full details of meiosis are described The account is accompanied by a historical résumé of triploidy in *Œnotheras*, an extensive bibliography, and 205 illustrations. J. S.

Haploid Mutant of Brassica Napellus.—T. Morinaga and E. Fukushima ("Karyological Studies on a Spontaneous Haploid Mutant of *Brassica Napellus*," *Cytologia*, 1933, **4**, 457–60). The paper reports the first known case of haploid plants in *Brassica*. The plants are highly sterile; seed collected from them produces diploid offspring. The leaves and flowers are smaller than those of the diploids, but the plants may grow taller because of their continuous development of inflorescences. A large number of these plants are found. The somatic chromosome number is 19. At heterotypic metaphase a variable number of bivalents ranging from none to seven are found and a few univalents. The number of chromosomes on the homotypic spindles varies from seven to thirteen, nine and ten being observed most frequently. The results are briefly discussed. J. S.

Chromosome Variation in Listera ovata.—M. Margaret Richardson ("Chromosome variation in *Listera ovata* R. Br.," *Univ. Calif. Pub. Bot*, 1933, **17**, 51–60). Variations in chromosome number are shown in material of *Listera ovata* collected in the field. Thirty-four or thirty-six somatic chromosomes are observed in normal plants, and one abnormal plant with three leaves contains thirty-five chromosomes. Fragmentation is discussed as the possible cause of these variations rather than the "non-disjunction" view held by Tuschnyakova (1929). Satellites are present in the species. J. S.

Chromosome Number and Morphology in Ficus.—I. Judson Condit ("Cytological and Morphological Studies in the genus *Ficus*. II. Chromosome Number and Morphology in Thirty-one Species," *Univ. Calif. Pub. Bot.*, 1933, **17**, 61–74). Root-tip preparations have been studied of thirty-one species of *Ficus*. The diploid chromosome number in each is 26. In a single cell of *F. pumila var. minima* a tetraploid complement was observed. The chromosomes of twenty-two species are morphologically alike, while the other nine species are characterized by U-shaped, V-shaped, or satellited chromosomes. A table is given showing chromosome numbers so far reported for forty-three species of *Ficus*. Chromosome morphology apparently has little significance in the taxonomic grouping of these species, although it does have a bearing on specific relationships of certain species, some of which may be of hybrid origin. J. S.

Triploid Pineapples.—J. L. COLLINS ("Morphological and Cytological Characteristics of Triploid Pineapples," *Cytologia*, 1933, **4**, 248–56). Triploid pineapples have been studied in the F_1 hybrid population produced by crossing *Ananas comosus* var. *Cayenne* and a wild species from Brazil believed to be *A. microstachys* Lindl. These triploids contain seventy-five chromosomes and arise from the fertilization of diploid egg gametes by normal haploid pollen, *Cayenne* being the female parent. Meiosis in the triploids is very irregular. Trivalents, bivalents, and univalents are formed in varying numbers in different cells. At metaphase the chromosomes are irregularly distributed over the spindle. The early tetrad stages appear normal, but later there is much degeneration of pollen. The triploids appear to be self-sterile, but a few viable seeds were formed by applying triploid pollen to *Cayenne* stigmas. The results are of great importance to pineapple breeders. J. S.

Chiasmata in Secale cereale.—C. D. DARLINGTON ("The Origin and Behaviour of Chiasmata. VIII. *Secale cereale* (n, 8)," *Cytologia*, 1933, **4**, 444–52). The two smaller segments (*k* fragments) in a plant of *Secale cereale* with sixteen chromosomes fail to pair in a proportion of pollen-mother-cells. Their chiasma frequency and that of their long and short arms is approximately proportional to their length. Terminalization is more complete in the fragment pair than in the major chromosomes. There is a negative correlation (— 0·330) between the chiasma frequency in the major chromosomes and that in the fragment pair of the same nucleus. The same plant with otherwise normal pairing had a group of eight cells each showing a ring or chain of four chromosomes. Spontaneous interchange is considered to have taken place in a common ancestral mitotic nucleus. J. S.

Meiosis in Agapanthus and Kniphofia.—C. D. DARLINGTON ("Meiosis in *Agapanthus* and *Kniphofia*," *Cytologia*, 1933, 4, 229–40). The fifteen paired chromosomes in *Agapanthus umbellatus* show from one to five chiasmata at diplotene. The number of terminal chiasmata increases at later stages. Equilibrium positions for different numbers of chiasmata are figured. Between pachytene and diakinesis the paired chromosomes first show condensation near the spindle-attachment, indicating that this point controls condensation. It is possible (1) to recognize a differentially stained attachment chromomere at pachytene, (2) to show that the nucleolus is attached interstitially to a particular chromosome pair at a particular point near the spindle attachment, and (3) to show that interlocking occurs with specially high frequency at the spindle attachment. An intermediate degree of differential condensation is seen in *Kniphofia aloides*. J. S.

Brassica Hybrids.—T. MORINAGA ("Interspecific Hybridization in *Brassica*. V. The Cytology of F_1 hybrid of *B. carinata* and *B. alboglabra*," *Jap. J. Bot.*, 1933, **6**, 467–75). The hybrid *B. carinata* ♀ (n = 17) × *B. alboglabra* ♂ (n = 9) was obtained with difficulty; the reciprocal cross gave no viable seeds at all. At heterotypic metaphase the hybrid shows sixteen chromosomes, consisting of nine bivalents and seven univalents. Somatic counts were unsuccessful, but the zygotic number is considered to be 25 instead of the expected 26. The discussion deals with the mode of bivalent formation in the hybrid and the genotypic constitution of the parental species. J. S.

Quamoclit Hybrids.—F. KAGAWA and G. NAKAJIMA ("Genetical and Cytological Studies on Species Hybrids in *Quamoclit*," *Jap. J. Bot.*, 1933, **6**, 315–26). *Quamoclit angulata* (*coccinea*) (2n = 28) × *Q. pennata* (2n = 30) gives an F_1 whose external characters are intermediate between those of the parents. The F_1 of

Q. coccinea var. *hederifolia* ($2n = 28$) $\times$ *Q. pennata* is also intermediate. The somatic number of chromosomes in both these F_1s is 29, corresponding to the sum of the haploid numbers of the respective parents. In F_1 *Q. angulata* $\times$ *Q. pennata* fifteen chromosomes are seen in late diakinesis. There are fourteen bivalents and one univalent from the pollen parent. Both heterotypic and homotypic divisions are irregular and laggard chromosomes are observed. In both hybrids studied dyads are often formed, polyspory is frequent, and the pollen grains differ greatly in size The possibility of the formation of a new species with the double number of chromosomes is discussed. J. S.

Synthesized Types in Datura.—A. F. Blakeslee, A. D. Bergner, and A G. Avery ("Methods of Synthesizing Pure-Breeding Types with Predicted Characters in the Jimson Weed, *Datura Stramonium*," *Proc. Nat. Acad. Sci.*, 1933, **19**, 115–22). A wide range of $2n + 1$ types is known in *Datura Stramonium*, but they cannot breed true. Now that knowledge has been gained of the effects of different parts of chromosomes when present as extras and that a source of modified chromosomes is available in the prime types it is possible to synthesize pure-breeding forms. The paper describes some of the methods of synthesizing types with extra chromosomal material. J. S.

Spermatozoids of Some Pteridophyta.—Akira Yuasa ("Studies in the Cytology of Pteridophyta. II. The Morphology of Spermatozoids of some Ferns," *Cytologia*, 1933, **4**, 305–37). Spermatozoids of the following species were studied :—*Polypodium aureum* L , *Adiantum Capillus-veneris* L., *Pteris cretica* L. var. *albo-lineata* Hk , *Leptogramme totta* J. Sm , *Polystichum varium* Presl , *Drymoglossum microphyllum* C Chr., and *Leptochilus zeylanicus* C. Chr. Full details of the staining technique adopted are given. In the spermatozoids of the seven species studied, six main parts could be distinguished, viz. nucleus, cilia-bearing band, border-brim, lateral bar, cilia and plasma fragment. These are described in detail for each species and the characteristics summarized after each description The differences observed can be taken as morphological characters specific to the ferns studied. The comparative studies of the spermatozoids, from the point of view of the phylogeny of fern groups, is left for future investigation. J. S.

Cytology of Spirogyra.—Tetsu Sakamura ("Beitrage zur Protoplasmaforschung an *Spirogyra*-Zellen," *J. Fac. Sci Imp. Univ. Hokkaido*, 1933, Ser. V., **2**, 287–316, 2 pls., 9 figs) The results of the investigation of the various granular particles in the *Spirogyra* cell both by transmitted light and with dark-ground illumination ; of the structure of the chloroplast ; and of the effects of plasmolysis A. G.

Anatomy and Morphology.

Woods of the Myristicaceæ.—D Normand ("Les bois de Myristicacées du Gabon," *Rev. Bot. Appl. et d'Agric. Trop.*, 1933, **143**, 471–9, 1 pl.). The characteristics of the woods of the Myristicaceæ are described. A key to the identification of the species occurring in Gaboon is followed by descriptions of *Scyphocephalium Ochocoa* Warb and *Cœlocaryon Klainei* Pierre, the latter illustrated by photomicrographs of transverse and tangential sections. Of the timbers of this family represented in tropical Africa, *Pycnanthus* is a soft, light wood without distinct duramen, *Staudtia* is hard and heavy, and the woods of *Cœlocaryon* and *Scyphocephalium* are intermediate in character. B. J. R.

Bearing of Wood Anatomy on the Relationships of the Myristicaceæ.—G. A. GARRATT (*Trop. Woods*, 1933, **36**, 20–44). Study of the comparative anatomy of the woods of this family lends support to the action of those systematic botanists who have placed the Myristicaceæ close to the Lauraceæ. The affinities of the Myristicaceæ with the Monimiaceæ and the Hernandiaceæ are not nearly so clear, though there are certain resemblances between the Myristicaceæ and the Monimiaceæ on the one hand, and between the Hernandiaceæ and the Lauraceæ. Some slight affinity is indicated between the Myristicaceæ and the Magnoliaceæ and Schizandraceæ of the order Magnoliales. There is no sign of any near relationship between the Myristicaceae and the Annonaceæ, Eupomatiaceæ, Canellaceæ, Menispermaceæ, or Lardizabalaceæ. B. J. R.

Comparative Anatomy of a Hybrid Betula and its Parents.—S. M. COUSINS (" The Comparative Anatomy of the Stems of *Betula pumila*, *Betula lenta*, and the Hybrid *Betula Jackii*," *J. Arn. Arb.*, 1933, **14**, 351–6). In some respects the hybrid, *Betula Jackii*, is intermediate between its two parents ; this applies to the size and distribution of the vessels, the width in cells of the rays, the proportions and wall characteristics of the pith cells. In other respects the hybrid resembles *B. lenta*, its pollen parent, since they both lack the " aggregate ray " areas (an appearance due to absence of vessels in certain areas), the scalloped cambium and annual rings, and the early-forming phloem-sclerenchyma that characterize *B. pumila*. In the character of the perforations of the vessel-ends the hybrid is unlike *B. lenta*, and closely resembles *B pumila*. B. J. R.

Ray Development in Woods of the Sterculiaceæ.—M. M. CHATTAWAY (" Ray Development in the Sterculiaceæ," *Forestry*, 1933, **7**, 93–108, 7 figs.). Ray development of the wood of various genera is traced by means of serial sections from the pith outwards. Increase in the number of rays, to keep pace with the increasing perimeter of the stem, is achieved in two ways : by subdivision of the fusiform initials to form uniseriate rays, and by the formation of several smaller rays from one large one by the reversion of ray initials to the fusiform condition. Increase in height and width of individual rays may occur either by swelling and division of existing ray initials or by addition of new ray initials formed from adjacent fusiform initials. The addition of new initials to the sides of the rays gives rise to the layer of " sheath-cells " which are characteristic of some genera. These genera are confined to the sub-family Sterculieæ, which stands apart from the rest of the family in this and other respects. B. J. R.

Key to the Identification of Coniferous Woods.—E. J. SLYPER (" Bestimmungstabelle für rezente und fossile Coniferenhölzer nach mikroskopischen Merkmalen," *Recueil trav. bot. néerland* , 1933, **30**, 482–513, 19 figs.). The key is a compilation based on the collected data of previous workers, which are listed in a bibliography of twenty-seven references It is pointed out that the presence or absence of parenchyma in coniferous woods is a variable character, and is consequently unreliable for diagnostic purposes. Diagnostic characters frequently occur at the end of the season's growth, and it is important to examine tangential sections passing obliquely through the ring boundary. It is important to distinguish between resin canals which are a normal feature of the wood and those which are formed as the result of a traumatic stimulus *Ginkgo biloba* is included in the key, as its wood has been confused with that of Coniferæ. Fossil woods which cannot be compared with any living types are excluded. B. J. R.

Bordered Pits of Coniferous Woods.—E. W. J. PHILLIPS (" Movement of the Pit Membrane in Coniferous Woods, with special reference to Preservative

Treatment," *Forestry*, 1933, 7, 109–20, 5 figs.). The relation between the proportion of aspirated (closed) pits and the moisture content of the wood of various conifers is discussed. The proportion of aspirated pits is usually very small in freshly felled timber; the number slowly increases as the moisture content falls, until fibre-saturation point is approached, when a rapid increase occurs. At this stage nearly all spring-wood pits have become aspirated, but a certain proportion of summer-wood pits remain unaspirated even in dry wood The mechanism of torus movement is discussed and a hypothesis put forward based on the laws of surface tension Variation in the proportion of aspirated pits in dry wood appears to be correlated with differences in the thickness of the radial walls of the tracheids. The results of the investigation are discussed in relation to the penetration of liquids and the difficulties encountered in treating coniferous timber with preservatives. B. J. R.

Structure of West African Timbers.—L CHALK, J. BURTT DAVY, H. E. DESCH and A. C. HOYLE ("Forest Trees and Timbers of the British Empire. II. Twenty West African Timber Trees," *Imperial Forestry Institute, Oxford*, 1933, 1–108, 20 pls., 20 figs.). The second issue of this series comprises full descriptions of twenty West African species, selected primarily on the commercial importance of their timbers. A brief discussion of each genus is followed by descriptions of the species concerned, which are drawn from the following genera: *Holarrhena, Afzelia, Hymenostegia, Terminalia, Ricinodendron, Garcinia, Ochrocarpos, Lovoa, Pseudocedrela, Piptadenia, Lophira, Mitragyna, Irvingia, Cistanthera*, and *Holoptelea*. The botanical descriptions are followed by notes on distribution, importance, and uses, and detailed descriptions of the structure and properties of the timbers, illustrated by photomicrographs of wood sections. B. J. R.

Development of the Wood of Desert Plants.—V. K. VASSILEVSKAYA ("The Development of the Wood in the Trees and Shrubs of the Sand Desert Kara-Kum," *Bull. Appl Bot, Gen. and Plant Breeding*, 1933, **1**, 231–60, 26 figs. Russian with English summary). According to the structure of the annual and perennial shoots, the vegetation of the Kara-Kum Desert is divisible into three types: I. Plants whose perennial wood shows a great number of living elements, while the branches are succulent (species of *Salsola* and other Chenopodiaceæ, and species of *Calligonum*; II. Psammophytes, species of *Ammodendron, Smirnovia*, and *Astragalus*; III. Plants growing on shifting sand, e.g. *Eremosparton flaccidum*. All three anatomical types are characterized by a number of common features, namely, brittleness, secondary sclerosis of the woody elements, very narrow rays, indefinite annual rings of relatively great width (2–5 mm.), early heartwood formation, and characteristic changes in wood structure due to the influence of the sand. The maximum annual rainfall is 200 mm.; having regard to this, the width of the annual rings is remarkable. The woody stems of trees and shrubs can be utilized for fuel after only twenty to twenty-five years. It is considered that the development of the woody plants in the sand-hills takes place under conditions of almost uniform water supply. The plants exist through the long rainless season at the expense of the water stored in their tissues; alternatively their roots are supplied by water rising through the sandy soil by capillarity. Certain deformations in the structure of the wood are ascribed to the shifting of the sand, differences of pressure on the stem affecting the activity of the cambium. B. J. R.

Nodal Anatomy of Spartina Townsendii.—ISABEL LANDER-THOMSON ("The Nodal Anatomy of *Spartina Townsendii*," *Trans. Bot. Soc. Edinb.*, 1933, **31**, 262–8, 5 figs.). The nodal anatomy in *Spartina Townsendii* was found to be

similar on the whole to that described by Arber for *Phalaris arundinacea* and *Avena barbata* and by Percival for the Wheat plant. Seventy bundles were found in an internode, which were treated in four groups: (1) first-leaf bundles—these were thirteen in number and formed the main bundles of the next foliage leaf; (2) second-leaf bundles, a set of smaller alternating bundles slightly farther from the centre; (3) cauline bundles, forming a ring around (1) and (2) abutting on the stereome of sclerenchyma; (4) subepidermal bundles, a ring of very small bundles in the tissue separating the subepidermal air-spaces. Each set has a special rôle. The first-leaf bundles gradually move inwards at the nodal plexus and then rapidly outwards into the leaf-sheath. The second-leaf bundles eventually become the first-leaf bundles of the next node. The cauline bundles by lateral branching form the network of the solid node. Passing upwards, various further branchings take place, a number of which become the second-leaf bundles of the next node. The subepidermal bundles are very small and undergo anastomosing and splitting. Above the nodal plexus large masses of sclerenchyma appear around them. Part of this sclerenchyma joins the first-leaf bundles as they pass outwards into the leaf. Amphivasal bundles were observed in the nodes. It is clear that the bundles passing to the first, second, and third leaf above take no part in the plexus. In the rhizome the arrangement is not the same as in the culms. Both roots and buds are present and there is a very simple nodal network. F. B.

Vegetative Propagation in Cotoneaster.—William A. Clark ("Vegetative Propagation in *Cotoneaster*," *Trans. Bot Soc. Edinb.*, 1933, **31**, 256–261, 2 pls.). In *Cotoneaster microphylla* slight protuberances are noted above almost every axillary bud on the older parts of a normal upright stem. Each is associated with a closing bud gap, while none is seen in the current year's growth. These protuberances are pre-formed root initials which originate as a group of cells in the bud gap. These initials remain dormant until natural or artificial layering is brought about or a cutting is made. It seems probable that the root initials are produced from the cambium of the stem The vascular tissue of the root initial forms a wedge-shaped structure which becomes embedded in the bud gap due to secondary growth of the stem and to sliding growth. When cuttings were used, callusing and rooting seemed to be negatively correlated, successful rooting depending on little callus formation. Cuttings propagated in March rooted most successfully, although a much larger amount of callus was formed on those inserted in October, November, and December. F. B.

Ephedra Cuttings.—R. J. D. Graham ("Stem Cuttings in *Ephedra*," *Trans. Bot. Soc. Edinb.*, 1933, **31**, 245–246, 1 pl.). Stem cuttings of *Ephedra nebrodensis* and other species of *Ephedra* were successfully raised within a month. A meristematic region occupies each node, which interrupts the lignified pith. A massive callus " cushion " over the basal end of the cutting is a product of tissues formed by the wood cambium and the nodal meristem respectively. The outer layers of the callus are suberized. Root development is oblique to the cut surface and roots appear at an obtuse angle to the stem. F. B.

Root System of Acanthus montanus.—A. McMartin ("The Root System of *Acanthus*," *Trans. Bot. Soc. Edinb.*, 1933, **31**, 272–297, 2 figs.). *Acanthus montanus* is an evergreen shrub with rather weak stems and a copious production of aërial roots. There is a lack of secondary conducting tissue and the deficiency is compensated for by the production of these roots. The mechanical concept of the roots as struts must take secondary place. Their internal structure is stem-like, with a peripheral conducting system and a wide pith. The soil root, however,

has a centralized vascular system. On entering the soil the aërial root shows corresponding anatomical changes. It is shown that the root initial is the same in soil and aërial roots; it is broad and has a high degree of stelar elaboration behind the apex. The difference in construction between the two types of root can be traced to the growing point It results from a differential growth between the histogenetic tissues corresponding with the environmental conditions in which the root-tip is growing. F. B.

Leaf Cuttings in Acanthus.—A. McMartin ("Propagation from the Leaf of *Acanthus*," *Trans. Bot Soc. Edinb.*, 1933, **31**, 298–314, 4 figs.). Isolated leaves of *Acanthus* (*montanus ?*) planted under suitable conditions regenerate a root system from the cut end of the petiole From one to four roots may be formed. The root arises from the pericycle and its internal construction is normal only for a short time. Rapid anatomical changes occur, the primary vascular system being destroyed by dilatation of the pith with the premature onset of secondary changes. It is suggested that the physiological conditions at the junction of petiole and root are peculiar and are productive of abnormal anatomical requirements. Eventually the cortex develops a swollen region on one side of the root on the periphery of which buds are initiated Within the swelling the primary root system disappears; the vascular strands become typical stem strands and to these the conducting system of the buds is united An analogy between these changes and those occurring in the hypocotyl of the seedling is made. F. B.

Development of the Tissues of the Tobacco Leaf.—G. S. Avery, Jr. ("Structure and Development of the Tobacco Leaf," *Amer J. Bot*, 1933, **20**, 565–92, 42 figs). An account of an intensive investigation of the development of the tissues in the tobacco leaf made on "Havanna Seed," "Cash," and "Cuban Shade" varieties of *Nicotiana tabacum* L. The leaf arises as a lateral projection which is initiated from a few localized dividing cells at the tip of the embryonic stem. A subepidermal cell at the tip of the leaf primordium behaves as an apical cell until the leaf is 2–3 mm. long. The lamina does not begin to develop until the midrib primordium is 0·6 mm. long, when a marginal meristem in the subepidermis gives rise to mesophyll mother-cells. The epidermis is self-perpetuating. When once the palisade and mesophyll layers have been laid down by the marginal meristem the cells are capable of perpetuating themselves by dividing in a plane parallel to the leaf surface. The cells of the epidermis are the first to cease dividing, followed by those of the mesophyll, and finally the palisade cells. Although the epidermal cells are the first to cease dividing, they continue to enlarge even after the cells of the other tissues have ceased to do so. The pull of the enlarging epidermal cells thus sets up a strain on the mesophyll cells, which are thereby pulled apart, and so the intercellular spaces of the uniformly spongy mesophyll are produced. "The reciprocal stresses of the developing spongy tissue on the cells of the lower epidermis cause its lateral walls to become distorted and wavy. A similar relationship exists between the upper epidermis and the palisade layer, but to a lesser degree." Palisade cells begin to acquire their characteristic shape when the leaf is 4–5 mm. long. The intercellular spaces of the spongy mesophyll, on the other hand, do not develop to any extent until the leaf is 8–10 cm. long. When the leaf is approximately 1 mm long the xylem and external phloem begin to differentiate in the midrib, but the internal phloem (which is confined to the midrib and more important lateral veins) is not differentiated in the midrib until it is about 2 mm. long. Quantitative expressions of the relative growth in different parts of the leaf were obtained by using a formula of Huxley's (Huxley, J. S.,

"Problems of Relative Growth," London, 1932). It was found that, on the whole, the marginal, central, and basal portions of the lamina increase in area to a greater extent than other parts of the leaf. The final shape of the mature leaf was found to be attained partly on account of differences in the distribution of growth, and partly on account of greater growth in one dimension than another in various parts of the leaf. C. R. M.

Callus Formation in Hibiscus Rosa-sinensis L. and Hevea brasiliensis Mull. Arg.—A. Sharples and H Gunnery ("Callus Formation in *Hibiscus Rosa-sinensis* L. and *Hevea brasiliensis* Mull. Arg.," *Ann. Bot.*, 1933, **47**, 827–39, 4 pls.). The authors found that if small pieces of bark are stripped from young stems of *Hibiscus Rosa-sinensis*, the medullary ray cells proliferate and grow outwards from the exposed surface of the wood beneath. The meristematic cells between the rays, which would normally develop into xylem elements, also grow into similar parenchymatous cells, but are smaller. Callus also develops from the cut edges of the bark surrounding the wound "Repeated mitosis, followed by tangential wall formation, results in a more or less radially disposed series of cell-rows, loosely aggregated at first, but later, by mutual pressure, becoming consolidated into a large-celled parenchymatous cushion about 1 mm. thick covering the surface of the wood." Meanwhile a phellogen, which has arisen within the bark callus, extends inwards just beneath the exposed surface of the callus cushion. The layer of cells thus cut off on the outside of the phellogen becomes suberized and forms a protective covering to the delicate cells beneath. A new cambium is now formed. This arises at the points where the severed ends of the old cambium impinge on the edges of the callus, "and like a slowly closing diaphragm sweeps gradually inwards until the opposing edges meet and the cambial cylinder is thus restored." Callus is formed in the same way in *Hevea brasiliensis*, except that the initial stages of proliferation are more deep-seated, since they occur below the cut ends of the medullary rays. In some experiments the bark was reflexed, but not detached from the parent stems. When this was done callus was formed on the inner face of the bark, where its formation was initiated by proliferation of the medullary ray cells and cambium detached at the time when the bark was removed. It was shown that in cleft grafts of *H. Rosa-sinensis* the stock and scion contribute equally to the production of callus tissue The authors lay special emphasis on the important part played by the medullary ray cells in producing callus, and point out that there is no sign of cambial activity until the callus is completely laid down. C. R. M.

Pollen.—R. P. Wodehouse ("Tertiary Pollen. II The Oil Shales of the Eocene Green River Formation," *Bull. Torr. Bot. Club*, 1933, **60**, 479–524, 56 figs.). This paper contains descriptions of the pollen grains of forty-three species of plants from thirty-four genera found in the oil shales of the Eocene Green River in Colorado and Utah. This represents only a small proportion of the different kinds of pollen found in the oil shales. Most of the species have yet to be identified. The grains are frequently packed so tightly in the shales that they can be observed only with difficulty. All the grains described in the present paper (with one exception) can be assigned to present-day genera or families. Eighteen of the species from thirteen genera have previously been recorded in the Green River flora in the form of other plant remains than pollen. Twenty-nine species from twenty-one genera, on the other hand, are new to the Green River flora. The author believes that the pollen of twenty-nine species was wind borne, and, moreover, that most of the plants producing it did not grow in or near water and were therefore likely to be preserved

only in the form of the easily dispersed pollen grains. The author gives a description of the probable appearance of the vegetation of the Green River Lake and its surroundings. Most of the paper consists of a list of the pollen grains, accompanied by descriptions of them. C. R. M.

Antarctic Pollen-grain.—A. C. SEWARD ("An Antarctic Pollen-grain; Fact or Fancy?" *New Phyt.*, 1933, **32**, 311–3, 1 fig.). In 1914 the author described a small body found in the siliceous matrix of a partially decayed stem, discovered on a boulder on the Priestley Glacier on the Antarctic continent, as a winged pollen-grain under the name *Pityosporites antarcticus*. Since then other botanists have stated that the body in question was erroneously described as a pollen-grain, and that it is in fact a shrivelled pith cell. The author, having re-examined the specimen, says in the present paper that he believes his original description and interpretation of the body were correct, and asks for more convincing evidence to the contrary before discarding *Pityosporites antarcticus* as a *nomen nudum*.
C. R. M.

Embryology of Podophyllum Emodi and Eranthis hiemalis.—T. ARZT ("Über die Embryobildung von Pseudomonokotylen (*Podophyllum Emodi* and *Eranthis hiemalis*)," *Beih. bot. Centralbl.*, 1933, **50**, Abb. 1, 671–96, 42 figs.). The irregular embryology of the pseudomonocotylous *Podophyllum Emodi*, and *Eranthis hiemalis* is described in detail. Using these facts, the author discusses the origin of the monocotylous habit, but he believes that a more complete study of the embryology of pseudomonocotyledons is necessary before the origin of the single cotyledon is made clear. It is pointed out that in pseudomonocotylous plants the first divisions of the egg cell are irregular. This is especially noticeable in the Polycarpicæ. C R. M.

CRYPTOGAMIA.

Pteridophyta.

Marsilea and Pilularia.—DUNCAN S. JOHNSON ("The Curvature, Symmetry, and Homologies of the Sporocarps of *Marsilea* and *Pilularia*," *Bull. Torrey Bot. Club.*, 1933, **60**, 555–63). The author claims that the sporocarp of *Pilularia* is not radial but zygomorphic, that is, bilaterally symmetrical with reference to a median or sagittal plane. It is therefore comparable with the sporocarp of *Marsilea*. In both genera the paired young soral canals open, one on each side of the mid-line of the ventral face of the capsule. The tubercle, pit, overlap of hypodermis, and fork of the vascular bundle all lie in the mid-plane of the capsule. The bending of the peduncle is always in the same sagittal plane. The direction of the primary bending is different, being hyponastic in *Marsilea*, epinastic in *Pilularia*. It becomes clear that the capsule of *Pilularia* is very closely equivalent to that of *Marsilea*, except that it has but two pairs of sori in each half in *P. globulifera* (one in *P. minuta*), whereas six or more sori are found in each half in *Marsilea quadrifolia*. A. G.

Bryophyta.

Morphology of Riccia.—S K. PANDE ("On the Morphology of *Riccia robusta* Kashyap," *J. Indian Bot. Soc.*, 1933, **12**, 110–21, 3 pls., 2 figs.). An account of the life-history of *Riccia robusta*, compared with that of other species, *R. Frostii*, *R. crystallina*, etc. *R. robusta* is monoecious; its antheridia and archegonia are described, as also some archegonial abnormalities. The development of the fruit from the oospore and the formation of the spores are followed out. The exospore is reticulate. A. G.

Malayan Lejeuneaceæ.—FR. VERDOORN ("Die von V. Schiffner (1893–1894) und von Fr. Verdoorn (1930) auf den indomalesischen Inseln gesammelten Lejeuneaceæ Holostipæ," *Meded. Bot. Mus. Herb. Rijks Univ. Utrecht,* 1933, no. 8, 51–71). A list of forty-two species of Lejeuneaceæ Holostipæ from Java, Sumatra, the Malayan Peninsula, and Ceylon, including descriptions of three new species belonging to *Lopholejeunea, Ptychocoleus,* and *Thysananthus* respectively.
A. G.

Indian Hepatics.—SHIV RAM KASHYAP and RAM SARAN CHOPRA ("Liverworts of the Western Himalayas and the Panjab Plain (Illustrated). II.," University of the Panjab, Lahore, 1932, pp. i–vi, 1–137, 31 pls.). The first part of this work appeared in 1929, contained 25 plates, and described the N.W. Indian species in the orders Anthocerotales, Marchantiales, and the anacrogynous Jungermanniales. The second part completes the work and is concerned with the Jungermanniales. Descriptions of the families, genera, and species are given, together with keys; and many of the species are figured. The complete work contains fifty-three genera and 164 species. A. G.

Kamtschatka Sphagnaceæ.—LIDIE SAVICZ ("Flore des Sphaignes de Kamtschatka," *Bull. Jard. Bot. Acad. Sci de l'U.R.S.S.*, 1932, **30**, 415–80, 7 pls.). A descriptive flora of the Sphagnaceæ of Kamtschatka based upon collections of about 700 specimens gathered by V. L. Komarov, V. P. Savics, and others on the Riabouchinsky Expedition of 1908–09, and more recently by the Krassiuks. It comprises twenty-seven species, thirteen of which are additions to the Kamtschatka flora. The most interesting species is *Sphagnum pulchrum,* which, though widespread over northern Europe and North America, has never been detected in Siberia. A review of the work of previous collectors is given; and there is a bibliography of sixty-nine papers that bear upon the subject. A. G.

Physcomitrellopsis.—K. M. GUPTA ("On the Structure of a New Species of Indian Mosses, *Physcomitrellopsis indica* Dixon sp. nov., from Benares," *J. Indian Bot. Soc.*, 1933, **12**, 122–8, 5 pls). An account of a new species of *Physcomitrellopsis* from Benares and Lucknow. The only other species known came from South Africa. The differences of the two species are pointed out, and the morphology of the new species is figured in detail. A. G.

North American Grimmiaceæ.—GEORGE NEVILLE JONES ("Moss Flora of North America North of Mexico: Grimmiaceæ," Newfane, Vermont, 1933, **2**, part 1, 1–65, 25 pls.). A Monograph of the Grimmiaceæ forming part of Dr. A. J. Grout's Moss Flora of North America. It treats of the genera *Glyphomitrium* (1 species), *Grimmia* (47), *Scouleria* (2), *Braunia* (2), *Hedwigia* (1), *Campylostelium* (1), *Ptychomitrium* (5), *Rhacomitrium* (9). Keys to the genera and species are provided, and numerous figures are supplied on the plates. A. G.

Mongolian Bryophytes.—V. F. BROTHERUS and L. I. SAVICZ ("Verzeichnis von A. A. Elenkin im Jahre 1902 in den Sajanen und der Mongolei gesammelten Moose," *Bull. Jard. Bot. Acad. Sci. de l'U.R.S.S.*, 1932, **30**, 81–96). A list of ten hepatics, four sphagna, and one moss gathered by A. A. Elenkin in 1902 in districts lying between the Mongolian Lake Kossogol and the Siberian town Irkutsk. A new species of *Didymodon* is described. A. G.

Japanese Mosses.—K. SAKURAI ("Beobachtungen über japanische Moosflora. IV. Laubmoosflora auf Insel Yakushima," *Bot. Mag. Tokyo,* 1933, **47**, 331–46). A list of seventy-nine species of mosses collected by Y. Doi in the island of

Yakushima in Ohsumi province in South Kiusiu. The number of genera represented is twenty-eight. Descriptions of twelve new species and some varieties are given.
A. G.

Thallophyta.

Algæ.

Archæomonadaceæ.—Georges Deflandre ("Seconde note sur les Archæomonadacées," *Bull. Soc. Bot. France,* 1933, **80**, 79–90, 41 figs.). Descriptions of twenty-six new species of Archæomonadaceæ from diatomaceous deposits in various parts of the world The majority of these species belong to *Archæomonas,* and one to *Archæosphæridium ;* the remaining species belongs to *Lithuropyxis,* a new genus. The author discusses the classification and affinities of the Archæomonadaceæ.
A. G.

Algæ of East African Lakes.—Florence Rich ("Scientific Results of the Cambridge Expedition to the East African Lakes, 1930–1. The Algæ," *J. Linn. Soc. (Zoology),* 1933, **38**, 249–75, 4 figs). The results of an investigation of forty-three gatherings of freshwater algæ from eleven East African lakes. A systematic enumeration of 116 species and numerous varieties is provided, including thirty-four species of diatoms, among which the forms of *Rhopalodia* are worthy of note. General remarks are made on the various groups, and the distinctive features of the several lakes are pointed out.
A. G.

Arachnoidiscus.—N. E. Brown ("*Arachnoidiscus.* An account of the genus, comprising its history, distribution, development and growth of the frustule, structure and its examination and purpose in life, and a key to and descriptions of all known species, illustrated," London, W. Watson & Sons, Ltd., 1933, 1–88, 7 pls.). Descriptions of the genus and of its twenty-six species, with a key to facilitate their determination. The history of the genus is discussed ; the structure and development are described in detail. Numerous photographic figures are provided in the plates ; an index of figures cited from previous authors gives also the revised names of the species. The dates of issue of the first eighty plates of A. Schmidt's "Atlas der Diatomaceenkunde," are recorded.
A. G.

Biddulphia.—Paul Schmidt ("Neue Ergebnisse zur Biologie und Karyologie der *Biddulphia sinensis* Greville," *Flora,* 1933, N.F. **28** (Karsten-Festschrift), 235–68, 2 pls.) An account of investigations made at the Heligoland biological station on the life history of *Biddulphia sinensis,* its periodicity, and its reproduction and alternation of generations.
A. G.

Podocapsa and Brachynema.—A. Ercegović ("*Podocapsa* et *Brachynema,* deux genres nouveaux chamésiphonales de la côte adriatique de Dalmatie," *Act. Bot. Inst. Bot. Univ Zagreb,* 1931, **6**, 33–7, 2 figs.). Descriptions and figures of two new genera of epilithophytic blue-green algæ, found on the Dalmatian coast. *Podocapsa* is a chamæsiphonal pluricellular alga which grows by vegetative multiplication and also produces spores ; it is of Pleurocapsoid affinity. It grows in association with *Dalmatella, Solentia* and *Hormatonema.* The other novelty, *Brachynema,* is of similar affinity, and in its manner of ramification approaches nearest to *Scopulonema ;* it is reproduced by spores.
A. G.

Soil Algæ.—Har Dyal Singh ("A Contribution to Our Knowledge of the Algal Flora of Lahore Soils," *J. Indian Bot. Soc.,* 1933, **12**, 102–9.). Fifteen samples of soils were collected at Lahore and submitted to culture in special rich

media favourable to the development of algæ. As a result, four species of green algæ, twelve of diatoms, and twenty-eight of blue-green algæ were identified. The methods and media employed are described. A. G.

Enteromorpha.—CARL BLIDING ("Über sexualität und Entwicklung bei der Gattung *Enteromorpha*," *Svensk Bot. Tidskr.*, 1933, **27**, 233–56, 18 figs.). An account of an investigation of the sexuality and development of several species of *Enteromorpha*. All the species multiply vegetatively by the production of new individuals from the attachment disc Some species have a parthenogenetic reproduction. *E. Linza* and *E. procera* showed no sexual reproduction, but produced 4-ciliate neutral swarmspores. *E. clathrata*, *E. prolifera*, *E. intestinalis*, and a form of *E. compressa* showed a regular alternation between sexual and asexual generations (morphologically similar); they had male and female plants which produced anisogametes, which fused and became zygotes. The latter germinated at once to plants which produced 4-ciliate zoospores; and these, without any resting stage, developed into male or female plants. A. G.

Sorocarpus.—R. E. SCHUH ("On the Distribution of *Sorocarpus*," *Rhodora*, 1933, **35**, 347) Though widely distributed, *Sorocarpus* is exceedingly scarce. It is recorded from five or six stations on the east coast of North America, from the British Isles, Heligoland, and the Baltic. It is found in the winter only, sparsely intermingled with *Ectocarpus confervoides* or *E. siliculosus*. A. G.

Dalmatian Algæ.—VIKTOR SCHIFFNER ("Meeresalgen aus Sud-Dalmatien, gesammelt von Franz Berger," *Oesterr. Bot. Zeitschr*, 1933, **82**, 283–304, 4 figs.). A list of about 100 marine algæ from the Sabbioncello Peninsula and twenty-eight from Lacroma Island collected by Franz Berger The novelties described are a new genus, *Pseudogelidium*, four species, and some varieties and forms. *Pseudogelidium* is founded on *Gelidium miniatum* (Lamx.) Kutz, and seems to have affinity with Gracilarieæ or Hypneeæ. Critical notes on the forms of *Laurencia obtusa*, of *Cladophora utriculosa*, and of *Dictyota*, are given. A. G.

Fungi.

Physoderma zoospores.—E. OJERHOLM ("Multiciliate zoospores in *Physoderma Zeæ-maydis*," *Bull. Torrey Bot. Cl.*, 1934, **61**, 13–8). Bi- and tri- as well as uniciliate swarmspores were observed. The biciliate are usually twice the size of the uniciliate forms, but fusion of uniciliate spores has not been seen. One case of fusion between a biciliate and a uniciliate was noted. No conclusion can be drawn yet as to their origin, whether by fusion or by incomplete cleavage.
F. L. S.

New Chytrids.—F. K. SPARROW, JR ("New Chytridiaceous Fungi," *Trans. Br. Myc. Soc.*, 1933, **18**, 215–8). Four genera new to science are described: *Septolpidium*, *Rhizidiopsis*, *Sherffelia*, and *Sporophlyctidium*. F. L. S.

Chytridiaceæ.—F. K. SPARROW ("Inoperculate Chytridiaceous Organisms Collected in the Vicinity of Ithaca, N.Y, with Notes on Other Aquatic Fungi," *Mycologia*, 1933, **25**, 513–36, 1 text-fig., 1 pl.). An account of twenty-four Chytrids, two of which are described as new, which set free zoospores by dehiscence of one or more papillæ, of three operculate Chytrids, two being new, and of twenty-nine aquatic fungi belonging to other families. F. L. S.

New Erysiphe.—E. WEST ("Powdery Mildew of Crape Myrtle caused by *Erysiphe Lagerstrœmiæ*, n.sp.," *Phytopath.*, 1933, **23**, 814–20, 2 figs.). An account

of the disease, typical of powdery mildew, and the fungus causing it, together with a specific diagnosis. The fungus, which overwinters in the leaf-buds, can be controlled by lime-sulphur spraying. F. L. S.

Ascobolaceæ.—H. C. I. GWYNNE-VAUGHAN and H. S. WILLIAMSON ("Notes on the Ascobolaceæ," *Trans. Br. Myc. Soc.*, 1933, **18**, 127–35, 20 text-figs.). The growth in culture and the initiation of fruit formation are described for *Ascobolus viridulus*, *A. Leveillei*, *A. equinus*, and *Saccobolus depauperatus*. When these *Ascoboli*, *A. furfuraceus* and *Dasyobolus immersus*, were cultured in the presence of ammonium compounds colourless or only slightly coloured spores were produced. These germinated more readily than the coloured forms. F. L. S.

Gibberella.—R. K. VOORHEES ("*Giberella moniliformis* on Corn," *Phytopath.*, 1933, **23**, 368–79, 3 figs.). The morphological characters of the imperfect and perfect stages of the species of *Giberella* studied were found to fit the descriptions of *Fusarium moniliforme* Sheld. and *G. moniliformis* (Sheld.) Wineland. Physiological and inoculations tests were performed. F. L. S.

New Diaporthe.—G. F. WEBER ("Stem Canker of *Crotalaria spectabilis* caused by *Diaporthe Crotalariæ*, n.sp.," *Phytopath.*, 1933, **23**, 598–605, 4 figs.). This new disease causes a very high percentage of infection. Perfect and imperfect stages are described, the latter being *Phomopsis Crotalariæ* n.f. nom. F. L. S.

Tolyposporium.—M. N. KAMAT ("Observations on *Tolyposporium filiferum*, Cause of 'Long Smut' of *Sorghum*," *Phytopath.*, 1933, **23**, 985–93, 4 figs.). Germination experiments showed that in water and liquid media promycelia are developed, while on solid media a germ-tube-like growth appears and this branches to form aërial conidia. F. L. S.

Wheat-stem Rust.—J. MCDONALD ("Two New Records of Physiologic Forms of Wheat-stem Rust in Kenya Colony," *Trans. Br. Myc. Soc.*, 1933, **18**, 218–23). Two more physiologic forms of wheat-stem rust are recorded, with data to show how they can be distinguished from previously known forms. One of the new forms is identified with the American form 34 while the other resembles the Canadian form 116. F. L. S.

Colombia Rusts.—F. D. KERN, W. H. THURSTON, and H. H. WHETZEL ("Annotated Index of the Rusts of Colombia," *Mycologia*, 1933, **25**, 448–504). Of the 215 species reported five are new and two new combinations are made. The list, arranged alphabetically under genera and species, is followed by an index of the 331 hosts. F. L. S.

Milesia.—J. H. FAULL ("The Biology of Milesian Rusts," *J. Arn. Arb.*, 1934, **15**, 50–86, 3 pls.). An account of our knowledge up to date of the biology of *Milesia*, together with original work, under the heads hosts, life-history studies, developmental periods, habits of spore-production, and host restrictions. F. L. S.

New Spruce-rust.—J. H. FAULL ("A Remarkable Spruce-rust, *Peridermium Parksianum*, n.sp.," *J. Arn. Arb.*, 1934, **15**, 86–8). The spermogonia of this rust found on needles of *Picea sitchensis* indicate that it is the haploid phase of a *Melampsoropsis*. Its triangular broad-based spermogonia and its linear and sometimes almost sigmoid æciospores are its most striking features. F. L. S.

Russula.—J. SHAEFFER ("*Russula*-Monographie," *Ann. Myc.*, 1933, **31**, 305–517, 2 pls.). This is the third and last part of a monograph, the first two

parts of which are to be published later. The first is to be general, the second synoptic, with numerous keys, and the third is the special and main section. Three groups are made: *Compactæ* with two sub-sections, *Gratæ* with nine, and *Ingratæ* with four sub-sections. Under each sub-section the respective species are described and annotated. At the end of the paper is a key of European species.

F. L. S.

Tremella mycetophila.—J. Ramsbottom ("*Tremella mycetophila* Peck," *Trans. Br. Myc. Soc.*, 1933, **18**, 253–6, 2 pls, 6 figs.). It is concluded from careful microscopical examination that the so-called *Tremella mycetophila* is merely an outgrowth on the pileus and stipe of *Collybia dryophila*. The chains of conidia within the tissues described by other authors were not present. F. L. S.

Exoperidium.—H. Lohwag ("Mykologische Studien. VIII. *Bovista echinella* Pat. und *Lycoperdon velatum* Vitt.," *Beih. Bot. Centralbl.*, 1933, **51**, 269–87, 4 text-figs., 3 pls.). The exoperidium of the Lycoperdaceæ has a complex structure. The orientation and form of the hyphal elements determine the method of dehiscence. In *Bovista echinella* and *Lycoperdon velatum* a white veil covers the warts and tears in flakes. The hyphæ of the exoperidium are of varying form and share certain characters typical of the secretory hyphæ of many fungi. As they form typical pseudoparenchyma, can be traced into the endoperidium, and can be distinguished in the trama and gleba, they are regarded as tramal structures and are named "permanent hyphæ." F. L. S.

Hendersonula.—R. M. Nattrass ("A New Species of *Hendersonula* (*H. toruloidea*) on Deciduous Trees in Egypt," *Trans. Br. Myc. Soc.*, 1933, **18**, 189–98, 5 text-figs., 2 pls.). An account of a fungus associated with a "die-back" disease. There is a sphæropsid form having brown-septate spores and a torula stage. Continuity between the two forms was established. F. L. S.

Memnoniella.—L. D. Galloway ("Note on an Unusual Mould Fungus," *Trans. Br. Myc. Soc.*, 1933, **18**, 163–6, 2 text-figs.). A fungus with hyaline sterigmata and black conidia produced in chains is regarded as identical with *Penicillium echinatum* Riv., but it is suggested that the generic name *Memnoniella* should be retained. F. L. S.

Helminthosporium.—R. W. G. Dennis ("Studies in the Morphology and Biology of *Helminthosporium Avenæ*," *Trans. Br. Myc. Soc.*, 1933, **18**, 223–39, 2 text-figs., 4 pls.). Pycnidia are described for the first time. Symptoms of the disease are described and classified, optimum temperatures were determined, and all stages of the disease were reproduced artificially with pure cultures of the fungus. The source of each year's disease is found to be in the grain. F. L S.

Alternaria and Macrosporium.—S. P. Wiltshire ("The Foundation Species of *Alternaria* and *Macrosporium*," *Trans. Br. Myc. Soc.*, 1933, **18**, 135–61, 6 text-figs., 3 pls.). The author's study of the *Alternaria-Macrosporium* group leads him to believe that three types are concerned: those forming long chains of somewhat shortly beaked spores, those rarely forming chains and the spores having long filiform beaks, those with spores borne singly, sarcinæform, no beaks, and usually with a major cross-wall accompanied by a constriction. The suggestion is made to discard the name *Macrosporium*, using *Alternaria* for the first two groups and *Thyrospora* for the third. F. L. S.

Azygozygum.—C. G. C. Chesters ("*Azygozygum chlamydosporum*, nov. gen. et sp. A Phycomycete Associated with a Diseased Condition of *Antirrhinum*

majus," *Trans. Br. Myc. Soc.*, 1933, **18**, 199–213, 1 pl., 4 text-figs.). The fungus, consisting of mycelium and spiny chlamydospores, was associated with diseased *Antirrhinum*, but could not artificially be induced to attack a living plant. In culture besides chlamydospores, bicellular structures or thick-walled fusion cells are formed. F. L. S.

Sclerotium Diseases.—R. REMSBERG and C. W. HUNGERFORD (" Certain Sclerotium Diseases of Grains and Grasses," *Phytopath.*, 1933, **23**, 863–75, 4 figs.). Fourteen fungi were obtained from sclerotial diseases, which have been increasing in occurrence. Perfect stages were not found, but the fungi have been placed in four groups according to their morphological and physiological characters, one of these corresponding to *Typhula graminum.* F. L. S.

Sector Formation.—L. D. GALLOWAY (" The Stimulation by Dilute Antiseptics of ' Sectoring ' in Mould Colonies," *Trans. Br. Myc. Soc.*, 1933, **18**, 161–3, 1 text-fig.). *Aspergillus terreus* grown on flour agar in the presence of salicylanilide produced sectors of light colour. Subcultures from the sectors on wort agar have remained constant. F. L. S.

Chestnut Disease.—H. KLEBAHN (" Eine Blattkrankheit der Edelkastanie und einige sie begleitende Pilze," *Zeitschr. f. Pflanzenkr. u. Pflanzensch.*, 1934, **44**, 1–24, 14 figs.). A new species of *Mycosphærella, M. castanicola*, was obtained by keeping *Castanea* leaves moist during winter. Genetic continuity was proved with *Septoria castanicola* Desm Other fungi found on the leaves and described in detail are *Lophiotrema castanea*, n sp , *Venturia castanea*, n.sp , and *Chalcosphæria pustula* (Pers.) v. Höhn *forma castanea.* F. L. S.

Galtonia Disease.—A. K. GRAMRAWY (" Rotting of *Galtonia* Bulbs caused by *Fusarium culmorum* (W G. Sm) Sacc. and *Penicillium corymbiforum* Westling," *Trans. Br. Myc. Soc.*, 1933, **18**, 249–53, 1 text-fig.). The two fungi were found to be actively pathogenic to the *Galtonia* bulbs under a variety of conditions, the *Fusarium* being the more active at high temperatures. F. L. S.

Clover Disease.—R. A. SILOW (" A Systemic Disease of Red Clover caused by *Botrytis anthophila* Bond.," *Trans. Br. Myc. Soc.*, 1933, **18**, 239–49, 2 text-figs., 1 pl.). The pollen grains of the clover are partially replaced by the fungus spores, which, on reaching the stigmas, lead to the development of intraseminal mycelium. This finally causes infection of adult plants. The fungus is fully described. F. L. S.

Peanut Disease.—N C. WOODROOF (" Two Leaf Spots of the Peanut (*Arachis hypogœa* L)," *Phytopath.*, 1933, **23**, 627–41, 6 figs.). The fungi are *Cercospora personata* (B. & C) Ell & Ev , with abrupt, obclavate or cylindrical conidia, and *C. arachidicola* Hori, more common but less destructive. F L. S.

Leaf-scorch.—D. B CREAGER (" A Leaf-scorch of *Narcissus*," *Phytopath.*, 1933, **23**, 770–87, 8 figs.) A detailed account of the causal organism, *Stagonospora Curtissii* (Berk.) Secc , of the disease which kills the leaves four to eight weeks before they would normally die. F. L. S.

Coffee Disease.—N J NARASIMHAN (" Black-rot of Coffee in Mysore," *Phytopath.*, 1933, **23**, 875–87, 5 figs.). The structure of the fungus is described. Its penetration of the leaves was observed only during the late sclerotial stage and not during the early pellicle stage. Blackening is regarded as being caused by secretion of oxidase into the tissues by the parasite. F. L. S.

Crinkle Disease.—P. CLINCH and J. B. LOUGHNANE (" A Study of the Crinkle Disease of Potatoes and Its Constituent or Associated Viruses," *Sci. Proc. Roy. Dublin Soc.*, 1933, **20**, 567–96, 2 pls., 9 figs.). As a result of their experiments described in the paper the authors suggest that crinkle is a mixture of two viruses each of which belongs to a distinct type. They found that needle inoculation resulted in a simple mosaic, while the aphid *Myzus persicæ* transmitted the second constituent of crinkle—a veinal mottle—while it fails to transmit the simple mosaic. F. L. S.

Lichens.

British Lichens.—W. WATSON (" Lichenological Notes. VII.," *J. Bot.*, 1933, **71**, 314–8). Watson in this paper has given a wide range of lichenological observation in Glamorganshire, Somerset, Isle of Man, and elsewhere. The notes are of special value, either as they correct or substantiate the statements of previous collectors. There are also numerous ecological notes of interest: as, for instance, the finding of *Usnea articulata* growing on stones in heathy ground. The description of *Lecanora conizæoides* seems to connect that lichen with *Lecanora pityrea* Erichs. A. L. S.

New Species of Collemaceæ.—R. DUGHI (" Une nouvelle espèce de Collemaceé, *Pyreno-collema aquensis* de Crozals & Dughi, n.sp.," *Bull. Soc. Bot. Fr.*, 1932, **79**, 846–50). Dughi has given a lengthy account of this lichen, which was found on the cortex of *Robinia Pseudacacia*. He gives a full description and answers any doubts as to the true nature of the pyrenium, showing that it is a true species and not, as might be supposed, a lichen parasitic on a *Collema* species. The new lichen is not uncommon. A. L. S.

Criticism of a Melanotheca Species.—KARL VON KEISSLER (" Ueber eine Arnold'sche *Melanotheca* Art," *Rev. Bryl. et Lichenol.*, 1933, **5**, fasc. 2–3. Keissler has demonstrated that a species placed under *Melanotheca* by Arnold is a true lichen parasite, to be classified as *Leciographa centrifuga*, parasitic on the thallus of *Lecanola polytropa*. A. L. S.

Lichens of San Bernardo.—M CENGIA-SAMBO (" Florula lichenica del Passo del Piccolo San Bernardo," *Ann. del Laborator della Chanousia Giard. Bot. Alp. San. Bern.*, n. 2, 1932, 1–38). From her study of soil conditions Cengia-Sambo concludes that a certain humidity is necessary for lichen development, as also an optimum of humic acid, though an excess of the latter tends to limit growth. The rocks of the region examined were siliceous: on the schists were developed *Gyrophoræ* and *Dermatocarpon* along with crustose species of *Lecidea, Aspicilia,* and *Verrucaria*. There was a distinct resemblance between these lichens and those of polar regions. In many of the specimens the spores were poorly developed. Important factors affecting the lichen growth were chiefly the composition and surface of the rocks due to the overflowing water, which introduced calcareous substance on the surface of the siliceous rocks. A. L. S.

New Genus of Roccellaceæ.—O. V. DARBISHIRE (*Ann. Crypt. Bot.*, 1932, **5**, 153–9, 1 pl.). The new genus and species *Roccellodea nigerrima* Darbish. is based on a specimen collected many years ago at Galapagos, where it grew on rocks. The internal structure of the podetium is characteristic of *Roccella* species: the medulla is formed of strands of hyphæ and the cortex is a wall of cells at right angles to the central strands; soralia are present; apothecia are lateral and semi-immersed on a gonidial base. These characters are described at length and compared with the species of allied genera A. L. S.

Roccella DC. and Usnea Ach.—O. V. DARBISHIRE (*Tom. cit.*, 160–6, 1 pl.). Two species, *Roccella hereroensis* Wain. and *R. mossamedana* Wain., have been carefully examined by Darbishire. They were found on rocks in South and Tropical Africa The gonidia have been determined as of *Protococcus* type, and other thalline characters have decided their position as belonging to Usneaceæ. Very full descriptions of both species are given. They are placed by the author in *Usnea*, subgenus *Neuropogon*. A. L. S.

Dactylina and Dufourea.—BERNT LYNGE ("On *Dufourea* and *Dactylina*, Three Arctic Lichens," *Skrift. om Svalbard og Istravet*, n. 59, 1933, 1–62, 2 pls.). After thorough research through literature and herbaria Lynge has definitely placed *Dufourea* under *Dactylina*, but ranking both as sections; the three species now fully determined and described are *Dactylina arctica*, Sect. *Dactylina*, *D. madreporiformis*, and *D ramulosa*, Sect. *Dufourea*. In a supplement is described *Dactylina endochrysea* from Yunnan, China, also a member of the latter section. Much information is given as to habitat and distribution, the latter intimately connected with Arctic geology and ice movements. A. L. S.

African Species of Acarospora.—A. MAGNUSSON ("Supplement to the Monograph of the Genus *Acarospora*," *Ann. Crypt. Exot.*, 1933, **6**, pp. 13–48). The species described were collected at various times in Southern Africa. Magnusson has presented them under two subgenera, *Xanthothallia* and *Phæothallia*, the former largely predominating in Southern Africa, a rich collection of which has been brought home from the deserts of Great Namaland. "There are as many yellow species in South Africa as there are brown species in Europe." Brown species are rare in Africa. All the species grow on rocks, etc. A few have been included from Japan and from North and South America. A synoptic key to the species described has been provided. A. L. S.

Cladoniæ of South Africa.—P. A. VAN DER BYL ("Korsmosse van die Unie van Sud-Afrika. III. Familie Cladoniaceæ," *Ann. van die Univ. van Stellenbosch*, 1933, **11**, 1–13, 1 pl). Keys to family and the genera are given, with descriptions of species and varieties. Fourteen species of *Cladonia* are described (in the Afrikaans language). A. L. S.

Brazil Lichens.—KARL REDINGER ("Die Graphidineen der Ersten Regnell'schen Expedition nach Brasilien, 1892–4. I. *Glyphis Medusulina* und *Sarcographa*," *Ark. För. Bot.*, 1933, **25**, N. 13, 1–20, 1 pl., 3 text-figs. "II. *Graphina* und *Phæographina*," *op. cit.*, 1933, **26**, 1–105, 7 pls., 1 text-fig.). Redinger gives a descriptive account of the lichens of the above genera which were collected in Brazil. The first group is distinguished by a stroma in which the lirellæ are grouped. In the second group the lirellæ are free. In both the alga is *Trentepohlia* (chroolepoid). In both papers all the species are more or less described at length: there are many new species and new varieties; their differences and peculiarities are set forth in the keys to the species, in their different sections, and with abundant illustrations Many of the species are purely tropical and grow on trees. Genera and species differ in the form of the lirelloid apothecia and in the colour and septation of the spores.

Study of Solorina crocea.—O. DARBISHIRE ("Beobachtungen an der Flechte *Solorina crocea* (L.) Adi.," *Flora*, 1933, **28**, 14–27, 1 pl.). This species of *Solorina* is distinguished by the presence of a double gonidial layer: an upper composed of a green *Coccomyxa* alga, and a closely connected blue-green layer of *Nostoc* cells. Opinions have differed as to the significance of the *Nostoc* cells, whether to regard

them as a normal algal symbiotic layer or as intruded cephalodia. The argument for regarding them as cephalodia is based on their later intrusions at the margin of the thallus. Darbishire, after careful research, dismisses that arrival. He describes the *Coccomyxa* gonidia as forming a layer somewhat compact and continuous at the base, but pushing upward to the cortex in pyramidal extensions. Beneath lies the *Nostoc* layer of blue-green cells with a tendency to extend into the upper layer. The hyphal cells from the medulla push up through both layers to the cortex. Darbishire also found nests of *Nostoc* cells in the medulla and near the margin of the thallus where growth was most active, but there was no evidence that they arrived from the open margin as intrusive cephalodia. This communal existence of algæ with fungus hyphæ is only possible when there is no parasitism, and is a striking example of symbiosis; this lichen therefore must be considered as one individual. The *Nostoc* occupies a considerable space co-existent with the *Coccomyxa* layer and cannot be regarded as a cephalodium of late arrival as in *Peltigera aphthosa*.

Growth of Cladonia Podetia.—Rudolf Weise ("Über Beeinflussung der *Cladonia* podetien in ihrer Wachstumsrichtung und Stellung," *Planta, Archiv für Wiss. Bot.*, 1933, **20**, pp. 166-93, 13 text-figs.). Weise gives the results of extended experiment and observation on the causes that influence the growth of *Cladonia* podetia. He has described at length the results obtained by subjecting the living plant to shade and other conditions, such as altering the conditions of growth—placing the podetia on the flat instead of the natural upright position and by varying the supply of light and moisture. He concludes that *Cladonia* podetia are influenced through light, moisture, and gravitation. If the natural position is changed they in time come back to the normal, differing in this respect according to species. The variation in gonidial increase depends on the position of the podetium. The influence of light is described, as on it depends the development of the algal constituent. All these findings are the result of experiments which are fully described and illustrated. Several *Cladoniæ* but especially species of the sect. *Cladina* were experimented with. A. L. S.

Fungal Hyphæ and Free Algæ.—Günther Schmid ("Die Verpilzung aërophiler Algen. Zum Flechtenproblem," *Festschrift zum Siebzigsten Geburtstage von George Karsten, Flora*, 1933, **28**, 211–34, 9 text-figs.). The author notes the widespread distribution of green algæ on the bark of trees, etc., almost constantly associated with fungal hyphæ, the latter easily demonstrated by colour reagents, the stain proving the almost constant association of the two organisms. The alga was evidently *Pleurococcus vulgaris* (or *Aptococcus*). The fungal constituent could not be determined. In cultures there was increase in the size of the hyphal cells with formation of conidia. Dead algal cells were frequent, but their destruction was not due to the fungus, the association between the two organisms being mostly mechanical. The hyphæ may, however, occasionally penetrate the alga by pressure: no haustoria were seen; much of the paper is devoted to the action of the colour reagents. An attempt was made to test relationship between those free algæ and the gonidia of neighbouring lichens, such as *Ramalinæ*. There are also observations on the relationship between hyphæ and gonidia in the lichen thallus: Schmid found that haustoria were very rare. The algæ in the free colonies were frequently killed by extreme cold, etc. In that case they became saprophytic fodder for the fungus. The question is raised as to harmful influences affecting the hyphæ of these colonies and further research is promised. A. L. S.

Lichens on Mosses.—E. BACHMANN ("Ueber den Lagerbau moosbewohnender Flechten," *Arch. f. Protistenkunde*, 1933, **79**, 416–67, 79 text-figs.). The lichens described grew mainly on moss stalks, but occasionally on the leaves and on neighbouring substrata. Twelve species belonging to *Bacidia*, *Lecidea*, and *Lopadium* were examined. Three types of thallus were distinguished, globose, flat, or spongy. The globose or spherical is the most frequent type, but it frequently spreads to the flat form; under the flat (crustose) form he describes *Bacidia* spp. which spread over neighbouring moss-cushions. The spongy type was exemplified in *Lecidea crassipes* and *L. assimilata*, porous in structure, but changing to the crustose or even to the globose formation. A. L. S.

Cephalodia on Opegrapha.—K. REDINGER ("Epigene Cephalodien auf *Opegrapha*," *Arch f Mikrobiol.*, 1933, **4**, 237–40, 5 text-figs.). The author investigated what seemed to be nests of blue-green algæ on *Opegrapha robusta* from Celebes. The algal cells were interwoven with the thallus hyphæ. This is the first record of cephalodia on Graphidaceæ. A. L. S.

Recent Lichen Literature.—A. LORRAIN SMITH (*Trans. Br. Myc. Soc.*, 1933, **18**, 93–126) This record of recent lichen literature presents a connected study of the papers on lichens that have been published during the last few years under a series of headings. Systematy and Ecology, as one would expect, bulk largely, but much work has also been done on the various aspects of lichen development—its components as well as the fruiting bodies. Considerable attention has also been paid to Morphology, Physiology, and Bionomics. The origin and formation of the lichen plant has been studied from many aspects, as also the occurrence of superficial outgrowths such as Soralia, Isidia, and Cephalodia, all of which present special problems to the student. Reproduction has been studied anew and it is being recognized more and more that a protruding trichogyne seldom, if ever, takes part in fertilization. Notes are given of some distinguished lichenologists who have recently passed away, among them Miss Matilda Knowles of Dublin, who contributed so much to the study of Irish lichens. A. L S.

NOTICES OF NEW BOOKS.

Medical Research Council.—Special Report Series, No. 188. Reports of the Committee upon the Physiology of Vision. XIII. Determination of the Sensitiveness of the Eye to Differences in the Saturation of Colours. By L. C. Martin, F. L Warburton, and W. J. Morgan 1933. 42 + x pp. Price 1*s*. net

Special Report Series, No 189 A Report by the Department of Health for Scotland Tuberculous Infection in Milk. 1933 38 + x pp. Price 9*d*. net.

Special Report Series, No 190. A Study of Growth and Development. By R. M. Fleming, with a Statistical Analysis by W. J. Martin. 1933. 85 + xi pp. Price 1*s*. 6*d*. net.

Special Report Series, No. 191. Diet and the Teeth, An Experimental Study. Part III. The Effect of Diet on Dental Structure and Disease in Man. By May Mellanby. 1934. 180 + xi pp., 46 plates. Price 5*s*. net.

Special Report Series, No. 192. Housing Conditions and Respiratory Disease. Morbidity in a Poor-Class Quarter and in a Rehousing Area in Glasgow. By C. M. Smith. 1934. 36 + xi pp. Price 9*d*. net

Special Report Series, No. 193. Dissecting Aneurysms By T. Shennan. 1934. 138 + xi pp., 5 plates. Price 2*s* 6*d*. net.

Special Report Series, No. 194. The Chemistry of Antigens and Antibodies. By J. R Marrack. 1934 135 + xi pp , 26 text-figs., 25 tables. Price 2*s*. 6*d*. net.

Published by His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2.

An Index to the Genera and Species of the Diatomaceæ and their Synonyms, 1816–1932.—Compiled by Frederick Wm. Mills, F.L.S., F.R.M.S. Part VII. December, 1933, Co—Cy. 77 pp. Part VIII, January, 1934, Cy—Di. 70 pp. Part IX, February, 1934, Di—Eu. 77 pp. Part . X, March, 1934, Eu—Ga. 77 pp. Published by F. W. Mills, Milton Damerel, North Devon , and (for colonial and foreign subscribers) by Wheldon & Wesley, Ltd , 2, 3, and 4, Arthur Street, New Oxford Street, London, W.C.2. Price 10*s*. per part.

Origines et Formes de la Pensée.—By F. Carrel. 1934. 115 pp. Published by Vigot Frères, Éditeurs, 23, Rue de l'École de Médecine, Paris.

The Elements of Experimental Embryology.—By Julian S. Huxley and G. R. de Beer. 1934. xii + 514 pp., 221 figs. Price 25*s*. net. Published by the Cambridge University Press, Fetter Lane, London, E.C.4.

Handbuch der biologischen Arbeitsmethoden. Lfg. 425. Methodik der Dunkelfeldmikroskopie. By F. W. OELZE. 1934. 69 pp., 59 text-figs. Published by Urban & Schwarzenberg, Friedrichstr. 105B, Berlin, N.24. Price RM 3.60.

The Laboratory: Its Place in the Modern World.—By D. STARK MURRAY. The Fen Series, No. 8. 1934. 117 pp. Published by The Fenland Press, 12, Henrietta Street, London, W.C.2. Price: Paper, 2*s*; cloth, 3*s*. net.

Anleitung zu optischen Untersuchungen mit dem Polarisationsmikroskop.—By Prof F RINNE and Prof. M. BEREK. viii + 279 pp., 335 text-figs. 1934 Published by Dr. Max Janecke Verlagsbuchandlung, Leipzig. Price RM 11.60.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, DECEMBER 20TH, 1933, AT 5.30 P.M., MR. CONRAD BECK, *C.B.E.*, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

Robert A. Hunter.	Bridge of Weir.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Frederic J. Aumonier.	Harrow.
Eric S. Horning, M A., D.Sc.	London.
Daniel F. Jofson.	Nelson.
Joseph R. Lomax.	Bolton.
Roy L. O'Sullivan.	Bournemouth.
Benjamin Spector, M.D.	Boston.
Hans E. Thalmann, Ph.D.	Java.

Donations were reported from :—

Messrs. C. Baker,—

An early type of Camera Lucida. (Probably Nachet.)

Emmott & Co., Ltd.—

" Modern Textile Microscopy." By J. M. Preston.

Messrs. Longmans, Green & Co., Ltd.—

" Researches on Fungi." Volume V. By Reginald A. H. Buller.

Mr. F. W. Mills, F.R.M.S.—

" An Index to the Genera and Species of the Diatomaceæ." Part VII. By F. W. Mills.

Votes of thanks were accorded to the donors.

New Council.—The Secretary read the By-Laws relating to the election of Council.

Nominations to serve on the Council for the ensuing year were read and approved.

Papers.—The following communications were read and discussed :—

Mr. E. E. Jelley, B Sc., A.I.C., F.R.M.S —

"A Method of Eliminating Lens-Flare from Gauss and Vertical Illuminators."

Dr. J. N. McArthur, M.R.C.S., L.R.C.P.—

"A New Type of Portable Microscope."

Mr. David Bryce, F R S.E., F.R.M.S.—

"Some New Species of Rotifera."

Hearty votes of thanks were accorded to the authors of the foregoing communications.

Announcements —The Secretary made the following announcements :—

The Rooms of the Society will be closed from December 22nd to December 27th, 1933.

The Biological Section will meet in the Pillar Room on Wednesday, January 3rd, 1934

The Annual General Meeting of the Society will be held on Wednesday, January 17th, 1934, when Mr. Conrad Beck. *C B E.*, P.R.M.S., will deliver his Presidential Address.

The Proceedings then terminated.

THE ANNUAL GENERAL MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, JANUARY 17TH, 1934, AT 5.30 P.M., MR. CONRAD BECK, *C.B.E.*, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Frederic J. Aumonier.	Harrow.
Eric S. Horning, M.A., D.Sc.	London.
Daniel F. Jofson.	Lancs.
Joseph R. Lomax.	Bolton.
Roy L. O'Sullivan, L.D.S.	Bournemouth
Benjamin Spector, M.D.	Boston.
Hans E. Thalmann, Ph D.	Java.

Nomination Certificate in favour of the following candidate was read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Albert Pentland.	Nottingham

Donations were reported from :—

Mr. F. W. Mills, F.L.S., F R.M.S.—

"An Index to the Diatomaceæ and their Synonyms." Part VIII. (Cy—Di.) By F. W. Mills

Prof. W. A. F. Balfour-Browne, P.R.M S.—

"A Text Book of Practical Entomology" By F. Balfour-Browne.

"Concerning the Habits of Insects" By F. Balfour-Browne.

"On Insects, An Introduction to Entomology." By F. Balfour-Browne.

Collection of author's separata.

Mr. Briscomb,—

"The Microscope and its Revelations" 7th edition. By Carpenter and Dallinger.

Mr. H. Wrighton, F.R.M.S.—

Two guineas.

Votes of thanks were accorded to the donors.

The Annual Report of the Council for the year 1933 was read by the Secretary as follows :—

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1933.

FELLOWS.

Since the last Report the Council deplores the loss to the Society by death of one of its distinguished past Presidents, Sir J. Arthur Thomson, who was elected to the Fellowship in 1885, and became President in 1910.

The Society has also suffered the loss of the following Fellows whose deaths have been reported during the year :—

Mr A. D Bell	Elected 1908.
Prof. R Ramsay Wright.	„ 1882.
Mr J D Roberts.	„ 1932.
Prof. J E Talmage.	„ 1891.
Mr J Williamson.	„ 1930

Twelve Fellows have resigned and seven have been removed from the Roll of Fellowship under By-law 31.

Sir Robert Hadfield, Bt., F.R S., and Sir Herbert Jackson, F R.S., have been elected to the Honorary Fellowship of the Society in recognition of their valued services to microscopical science.

Twenty-six Ordinary Fellows have been elected during the year, and three have been reinstated.

MEETINGS.

Eight Meetings of the Council, and eight Ordinary Meetings of Fellows have been held which have been well attended.

JOURNAL.

The Council reports with gratification that the high standard of the Society's Journal as an authoritative publication on pure and applied microscopy is well maintained, and notwithstanding the high cost of printing and illustrating and the continued financial depression which for the last few years has prevented many Dominion and foreign institutions from renewing, for the time being, their annual subscriptions, the service rendered by the Society in the publication of original communications and the extensive series of abstracts and reviews of current English and foreign publications is universally recognized

The Council regrets that it has not been possible to include a complete description of Mr. Barnard's apparatus for ultra-violet microscopy in the current volume, and expresses the earnest hope that this will be available for publication in the near future.

The thanks of the Fellows are due, and are hereby conveyed to the Editorial Committee, the Panel of Abstractors, and to the Honorary Editor, Dr. G. M. Findlay, for their valued services to the Society during the year.

LIBRARY.

The Library is in good order and condition, and the number of visitors thereto since the last report is two hundred and twelve

One hundred and thirty-five volumes have been borrowed from the Library, excluding the number of volumes consulted by visitors. In addition to the foregoing nine volumes have been loaned to the National Central Library, and five volumes have been borrowed therefrom to meet the requirements of Fellows.

Forty volumes have been donated to the Library during the year, exclusive of the normal accessions received in exchange for the Society's publications. The Library has also been enriched by a valued donation from Mr. C. D. Soar of three volumes of his original drawings of the British Hydracharina which the Council has gratefully acknowledged.

The thanks of the Fellows have also been conveyed to the following donors for

additions to the Library :—Mr. Frederick Adams, the Biological Stain Commission, Geneva, N.Y., Miss Lucy Boyd, Trustees of the British Museum, Casa Editrice L. Cappelli, Messrs. Chapman & Hall, Ltd., Dr. G de Toni, Mr. Arthur Earland, Messrs. Emmott & Co., Ltd., the Executors of the late Mr. Abram Flatters, the Misses Harman, Prof. S. R. Kashyap, Mr. Sydney T. Klein, M. Paul Lechevalier, Liverpool University Press, Messrs. Longmans, Green & Co., Ltd., Messrs. McGraw-Hill Publishing Co., Messrs. Methuen & Co., Ltd., Mr. F. W. Mills, Mr. Sydney H. Robinson, Mr. R. Sheldrake, and Mr. C. D. Soar.

The congratulations of the Council have been conveyed to Mr. F. W. Mills, who, after many years' bibliographical research and compilation, is publishing an invaluable work of reference in " An Index to the Genera and Species of the Diatomaceæ and their Synonyms," which is dedicated to the Fellows of the Society.

INSTRUMENTS AND APPARATUS.

The Curator reports that the historical collection is in good condition and has been inspected by a number of visitors throughout the year, notably from the Dominions and from Holland and America. The hope has been expressed that the admirable method of exhibiting the collection in well illuminated cases will be extended to accommodate further unique examples in the Society's possession of early instrument-makers' craftsmanship.

The collection has been further enriched by an excellent example of an early high-power binocular microscope by Nachet, purchased by Members of Council and presented to the Society, and also by an early prism Camera Lucida, probably by Nachet, generously donated by Messrs. C. Baker.

In addition to the foregoing, the Council has acknowledged accessions from the following donors :—

W. H. Gillett, Esq., F.R.M.S.—

A Camera Lucida.

Messrs. Bausch & Lomb Optical Co., Ltd.—

Replica of Leeuwenhoek's microscope, *c.* 1665.

Mr. S. H. Robinson, F.R.M.S.—

2 Powell & Lealand sub-stage condensers and stops.
1 double nose-piece, frog plate, and 2 Lieberkuhns.

SLIDE CABINET.

Through the generous response of several Fellows and friends to the Council's appeal last year for aid in rendering the Society's Slide Collection of more practical assistance to students and others, the Council reports, with grateful acknowledgment, the following donations :—

Mr. John A. Long, F.R.M.S.—

595 Species slides of Diatoms.

Rev. P. Dingley Fuge,—

131 Species slides of Diatoms.

Mr. S. H. Meakin,—

20 Species slides of Diatoms.

Mr. F. Adams, F.R.M.S.—
50 slides of Kitton's Norfolk Diatoms.
39 slides of Cleve diatom mounts.

Mr. S H. Robinson, F.R.M.S.—
12 micro-slides. (Miscl.)

Exors. of the late Mr. Abram Flatters,—
49 micro-slides. (Miscl.)

These valued accessions, which the Society is proud to possess, considerably enhance the usefulness of the Cabinet as a reference collection to those engaged in the study of these organisms and requiring to refer to authenticated species slides; and it is gratifying to report that further promises of support have been received which the Council highly appreciates in its endeavour to stimulate and encourage workers in microscopical studies by rendering this practical service.

The Cabinet has been consulted on several occasions during the year and thirteen slides have been borrowed therefrom and duly returned.

STANDARDIZATION OF BIOLOGICAL STAINS.

In view of the importance of stains and staining materials used by microscopists engaged in biological investigation and research, and with a view to mitigating the variability of stains at present available, the Council has appointed a

> Committee to consider the standardization of biological stains and staining materials manufactured in this country, and to make recommendations to Council of standard specifications and tests for adoption with a view to the certifying of manufactured stains conforming to such standards.

In addition to those Fellows of the Society appointed by Council to serve on the Committee, the following official bodies have appointed representatives to serve thereon:—Medical Research Council, Royal Society of Tropical Medicine and Hygiene, Institute of Chemistry, the Chemical Society, Society of Chemical Industry, Pathological Society, and the Physiological Society.

The Committee has held several Meetings during the Session, and the drafting of standard specifications for Methylene Blue, Acid Fuchsin, and Eosin are under consideration. In addition, a standard specification for Xylol for microscopical purposes is receiving attention. Other stains will be dealt with as soon as the biological tests of those in hand have proved them to be satisfactory.

It is felt that with this organized co-operation between chemists and biologists, manufacturers of British stains will welcome the results of the Committee's deliberations.

GENERAL.

The use of the Society's table at the Marine Biological Laboratory, Plymouth, was granted to Mr. David Bryce for one week during the past year.

The congratulations of the Fellows were duly conveyed to the Royal Entomological Society upon the attainment of its Centenary Meeting in May last, Prof. W. A. F. Balfour-Browne and Prof. E. Hindle representing the Society on that occasion.

Mr. H. M. Carleton was appointed to represent the Society on the occasion of the 250th anniversary of the opening of the old Ashmolean Museum at Oxford.

The congratulations of the Fellows were duly conveyed to the Delaware Institute of Science on the occasion of its Centenary Meeting in September last.

APPENDIX.

BIOLOGICAL SECTION.

The Honorary Secretary of the Biological Section reports that the Section held seven meetings during the year. The attendance at these was fully maintained at the level of recent years, namely, an average of just over twenty. Many very interesting communications and exhibits were brought before the Section, giving rise in most cases to valuable discussion Although it is not usual in this report to refer to these individually, an exception may perhaps be made in the case of a most useful résumé of the present state of knowledge concerning Spirochætes given at the February meeting by Prof. Hindle. No visits were made during the year to the Laboratories of other Societies and Institutions.

On the motion of Mr. E. A. Robins, seconded by Mr. C. H. Bartlett, the following resolution was carried unanimously :—

"That the Annual Report be received and adopted."

It was further resolved, on the motion of Dr. A. S. Burgess, seconded by Mr. J. T. Holder :—

"That a hearty vote of thanks be tendered to the Officers and Members of the Council for their services during the past year."

Prof. R. Tanner Hewlett responded.

New Council.—The President appointed Mr. C. H. Oakden and Mr. A. J. Bowtell to act as Scrutineers of the ballot for the election of Officers and Members of Council for the ensuing year, and subsequently upon receipt of the Scrutineers' report, declared the result of the ballot as follows :—

President.—Prof. W. A. F. Balfour-Browne, M.A., F.R.S.E., F.Z.S., F.R.E.S.

Vice-Presidents.—J. E. Barnard, F.R.S., F.Inst.P. ; Conrad Beck, *C.B.E.* ; Prof. D. M. Blair, M.B., Ch.B. ; G. M. Findlay, *O.B.E.*, M.D., D.Sc.

Hon. Treasurer.—C. F. Hill, M.Inst.M.M., A.Inst.P.

Hon. Secretaries.—R. T. Hewlett, M.D., F.R.C.P., D.P.H. ; J. Smiles, A.R.C.S.

Ordinary Members of Council.—A. S. Burgess, M.A., M.D., B.Ch. ; R. S. Clay, B.A., D.Sc., F.Inst.P. ; R. Ruggles Gates, M.A., Ph.D., LL.D., F.R.S., F.L.S. ; E. Hindle, M.A., Sc.D., Ph.D. ; B. K. Johnson, D.I.C. ; J. E. McCartney, M.D., Ch B , D Sc , E K Maxwell, B A. ; A. More, A.R.C.S., A.R.T.C., F.I.C. ; J Rheinberg, F Inst P , E A. Robins, F.L.S. ; G. S. Sansom, D.Sc. ; D. J. Scourfield, I S.O., F L S , F Z S.

Hon Librarian.—C. Tierney, D.Sc., F.L.S.

Hon Curator of Instruments.—W. E. Watson Baker, A.Inst P.

Joint Hon. Curators of Slides.—N. I. Hendey, M.P.S. , E. J. Sheppard.

On the motion of the President, a vote of thanks was accorded to the Scrutineers for their services.

Presidential Address.—Mr Conrad Beck, *C.B.E* , then delivered his Presidential Address on :—

" Some Recent Advances in Microscopy "

at the conclusion of which, and on the motion of Sir Herbert Jackson, seconded by Mr. J. Rheinberg, the following resolution was carried with acclamation :—

> " That the best thanks of this meeting be accorded to Mr. Conrad Beck for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society."

The President responded.

Announcement :—The Secretary announced that the Biological Section would meet in the Pillar Room, on Wednesday, February 7th, 1934, at 6 p.m.

The proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, FEBRUARY 21ST, 1934, AT 5.30 P.M., DR. G. M. FINDLAY, *O.B E.*, VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

Albert Pentland. Nottingham.

Nomination Certificate in favour of the following candidate was read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Rev. Dingley P. Fuge. Shipley.

Deaths.—The Chairman reported the regrettable loss to the Society, by death, of the following Fellows :—

Dr. Dukinfield H. Scott, F.R.S., *past President.* Elected to the Fellowship in 1880.

Rev. Canon G. R. Bullock-Webster. Elected 1920.

Mr. J. W. Ogilvy. „ 1907.

Mr. T. Chalkely Palmer. „ 1910.

The Fellows signified their condolence with the relatives by standing in silence.

The following **Donations** were reported and votes of thanks accorded to the donors :—

Mr. F. Carrel, F.R.M.S.—
"Origines et Formes de la Pensée" By F. Carrel.

Messrs. Watson & Sons, Ltd.—
"Arachnoidiscus" By N. E. Brown.

Mr. John A. Long, F.R.M.S.—
110 species slides of diatoms.

Mr. F. W. Mills, F.L.S., F.R.M.S.—
"An Index to the Genera and Species of the Diatomaceæ." By F. W. Mills. Part IX. Di—Eu. 1934.

British Drug Houses, Ltd.—
"The B.D.H. Book of A.R. Standards." 2nd edition.
"B.D.H. Reagents for 'Spot' Tests." 2nd edition.

Syndics of the Cambridge University Press—
"Elements of Experimental Embryology." By J. S. Huxley and G. R. de Beer.

Mr. C. H. Bartlett, F.R.M.S.—
One guinea.

Papers.—The following communications were read and discussed :—

Prof. R. Tanner Hewlett, M.D., F.R.C.P., F.R.M.S.—

"Microbic Disease affecting Shaving Brush Bristles."

Mr. J. E. Barnard, F.R.S., F.R.M.S., and Mr. F. V. Welch, F.R.M.S.—
" A Method of Sealing Wet Preparations."

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The Chairman announced that the Biological Section would meet in the Pillar Room on Wednesday, March 7th, 1934.

The Proceedings then terminated.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1934.

TRANSACTIONS OF THE SOCIETY.

VI.—CILIATES FROM BERMUDA SEA URCHINS.* I. METOPUS 576

By MIRIAM SCOTT LUCAS
(Anatomical Laboratory, Washington University, St. Louis).

ONE TEXT-FIGURE AND FOUR PLATES (TWENTY FIGURES).

(*Read May 16th*, 1934.)

PLATES.

THE present investigation upon the ciliates which occur in the intestinal cæca of Bermuda sea urchins was begun in the summer of 1930. The majority of these ciliates belong to existing genera, and in some cases are species which have already been described from these islands or elsewhere. Previous reports have, however, in many cases been intended for purposes of mere identification, and, therefore, are morphologically and cytologically inadequate.

In addition to their taxonomic and historic interest, sea urchin ciliates, as a group, are receiving considerable attention at the moment because of the readiness with which they lend themselves to cytological study and to investigations of the neuromotor apparatus.

Material.

Representatives of three genera of sea urchins were examined for their parasitic ciliates at Bermuda in 1930; in addition, fixed material (preserved intestinal contents) has been kindly forwarded from the Bermuda station by the present Director, Dr. J. F. G. Wheeler.

* Contributions from the Bermuda Biological Station for Research. No. 167.

Hipponöe esculenta (*Tripneustes*) was collected from a grassy bottom, at half tide, off Cooper's Island. The shell diameter of this sea urchin varied from 69 mm. to 140 mm. *Diadema setosum* was found to be abundant in Castle Harbor in about 15 feet of water, in and about rocky recesses. The diameter of the shell was remarkably constant, varying between 60 mm. and 65 mm. The spines were frequently as long as 150 mm. *Toxopneustes variegatus* (*Lytechinus*) proved to be the most common sea urchin of the islands. It was collected in abundance at low water off Agar's Island, near Partridge Island, and in Castle Harbor. The shell diameter varied from 41 mm. to 70 mm. Fixed material from *Eucidaris* and *Echinometris* was forwarded from the station by Dr. Wheeler.

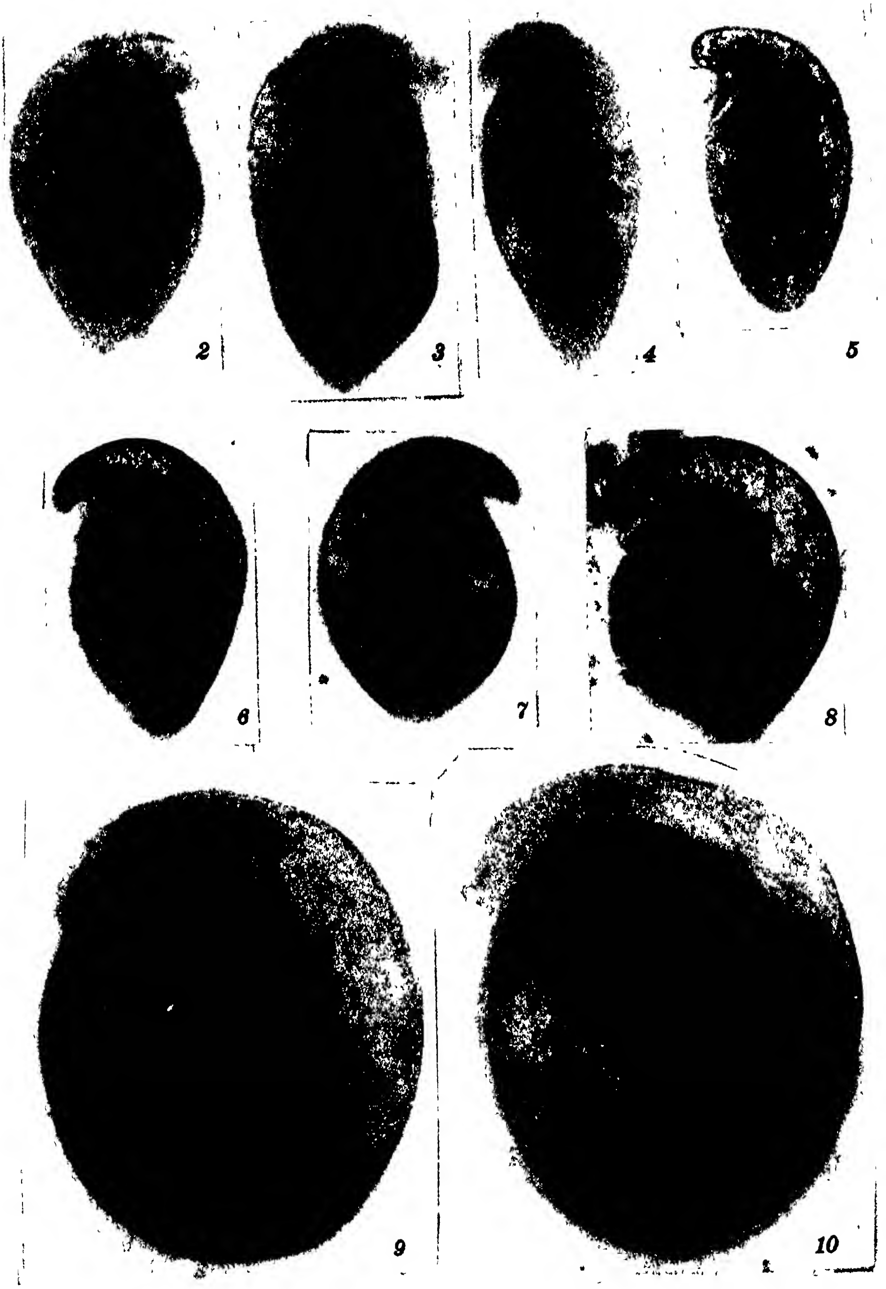
Methods.

At the Bermuda station the hosts were examined either soon after they were collected or were placed in a " live car " which was anchored in currents of water off Agar's Island. Several days of such environment produced no visible influence upon the sea urchins, but after a period of about 6 days or so, it was obvious that the intestinal tract had lost most of its solid contents, which were not replaced, and that the ciliates therein had diminished in number.

In preparation for the removal of intestinal contents, the spines of the upper half of the sea urchin were cut off close to the shell. The shell was then cut around completely, in a transverse plane, at a level so high that the intestine was not seriously torn. The ciliates were removed along with debris from the intestine, by means of a blunt-end pipette inserted into each of the intestinal cæca. The possibility of contamination with matter from other organs was thus lessened. As a result, it was determined that as long as the intestinal wall remained intact, the protozoa were limited to the lumina of the alimentary coils, and that only when injury to the intestine occurred, permitting their escape, were they found elsewhere among the sea urchin's organs. Transient protozoa encountered in the body fluids were normally free-living forms, which probably gained entrance through the water-vascular system, and gave no evidence of colonization.

The ciliates were most abundant in the pouches of the upper intestinal coil ; relatively few occurred in the lower region and in the rectum. No free ciliates were found in aquaria which contained sea urchins, nor were any ciliates of this group found among algæ or other food matter of sea urchins. The mode of transmission from host to host, therefore, is unexplained. Upon removal from the intestinal tract of the host, the ciliates continued their active locomotion for several hours in the intestinal fluid, and almost equally as long in ordinary sea water. Jacobs definitely determined that their period of activity after removal from the host was as long as 3 days under ordinary laboratory conditions and as great as 7 days when deprived of oxygen.

Face p. 80.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Fixation of the material was accomplished either by fixing the intestinal contents in bulk in a large quantity of fluid, or by isolating and fixing the individual protozoa. The fluids used were Schaudinn's fluid, modifications of Bouin's fluid (see McClung, 1929, p. 424), Jorgensen's fluid, and Vom Rath's fluid. Vom Rath's fluid was found to be an excellent fixing agent, particularly for the larger ciliates.

Stains used were Heidenhain's iron hæmatoxylin with various counter stains, Regaud's hæmatoxylin, and Mallory's triple connective-tissue stain. Some of the material was stained in bulk and some of it was previously sectioned (Lucas, 1919; Rees, 1931). The Feulgen thymonucleic acid reaction was performed on sectioned material (Lucas, 1930).

Acknowledgments.

The writer wishes to extend thanks to Dr. E. L. Mark, during whose directorship the work was initiated at the Bermuda Laboratory, and to the present director, Dr. J. F. G. Wheeler, who has kindly forwarded material from the islands, and to Dr. D. H. Wenrich for his suggestions and helpful criticism at the outset of the study.

The Genus Metopus.

Metopus circumlabens, a heterotrichous ciliate, occurs in the intestinal tract of practically 100 p.c. of the adults of *Diadema setosum* and commonly in those of *Echinometris subangularis* living in waters about Bermuda Islands. Rarely, a second species, *Metopus rotundus* n.sp., occurs in *Diadema*. The ciliate apparently remains in the sea urchins as a commensal, its feeding habits being almost entirely holozoic, its food consists of diatoms, small fragments of algæ and, infrequently, cellular debris which may have been derived from the mucosa sloughing off the host's intestine.

Kahl's (1927) comprehensive study of the genus *Metopus* serves as a basis for classification. An unidentified species of this genus was noted in the intestinal tract of *Diadema setosum* at the Tortugas by Jacobs (1914), and although recognized by him as being allied to *Metopus*, was designated simply as "B." Biggar and Wenrich (1932) have described *Metopus circumlabens*, from *Diadema setosum* and *Echinometris subangularis* from the Bermuda Islands.

According to these authors *Metopus circumlabens* occurs in large numbers in the hosts mentioned above; the living ciliate is 170μ long by 100μ broad; the greatest breadth, exclusive of the hook-like anterior portion, obviously extends through the middle third of the body length. The macronucleus is ovate.

Metopus circumlabens Biggar.

Size.—*Metopus circumlabens* varies greatly in size. All but three individuals of *Diadema* examined carried only typical circumlabens type, which

varied from 70μ to 125μ (average, 95μ) in length by 44μ to 75μ (average, 58μ) in breadth, exclusive of cilia (figs. 1–8 inclusive, 13, and 14). The majority encountered, therefore, were smaller than measurements given by other authors for this species; some discrepancy is to be expected, since the present measurements were made upon fixed specimens.

Shape.—The ciliate shows also considerable individual variation in morphology. Figs. 2–8 represent ciliates showing no evidence of fission; these were photographed from three preparations. Figs. 2, 3, 4, and 5 are photographs of individuals which were fixed in Schaudinn's fluid; the one shown in fig. 8 is from Vom Rath's fixation; and figs. 6 and 7 are from material fixed in Allen's B_{15} modification of Bouin's fluid. The character of the fixing fluid produced little or no consistent effect upon cell contour, if one may judge from these observations. This conclusion is likewise verified by observations upon living ciliates, in which comparable morphological variation occurs. Certain additional differences, particularly in shape, are doubtless changes which accompany fission processes (text-fig. 1, *a* to *e*).

At the present moment the author sees no valid reason for creating distinct species for the variations such as are indicated in fig. 5 (dorsal view) nor for those shown in figs. 7 (ventral view) and 8 (dorsal view). The form of the anterior region (crest) of the protozoan is modified frequently during the movements of the animal; this change of shape, in turn modifies the lateral peripheral contour (*cf.* figs. 13 and 14) and the angle assumed by the peristome toward the oral border (*cf.* figs. 5 and 8). The posterior tip of the cell is also contractile. All of the variations shown in figs. 2–8 inclusive are, therefore, considered under the same species, *Metopus circumlabens.*

When viewed from the ventral surface, the body outline of *Metopus circumlabens* resembles a reversed and somewhat broadened interrogation mark (figs. 1 and 13). The *dorsal surface* is flattened (figs. 16 and 17) with a mild curvature at the anterior and the tapering posterior regions. Except for the oral depression (peristome) the *ventral surface* is strongly convex, especially in the region occupied by the macronucleus. This surface at the anterior end tapers abruptly into the peristomal depression and at the posterior it tapers gradually towards the extremity. The region anterior to the peristomal depression has the form of a " crest " which originates upon the protozoan's right side, at the level of the cytostomal opening, and in general follows the latero-anterior body curvature anteriad along the peristomal depression, and ends in a hook-like flap upon the left side above the origin of the peristomal groove. The upper surface of the peristomal groove is formed by the crest. The crest is flexible.

The *peristome* is a curved depression, or trough, which originates upon the protozoan's left border, within the limits of the anterior third of the cell; it makes a curvature anteriad, extends transversely across three-fourths of the breadth of the cell in this region, where it turns directly posteriad (pl. I). The peristomal depression terminates at a cytostome, which

occupies a position upon the ventral surface about midway between the ends of the animal. The cytostome, in turn, merges abruptly into the cytopharynx. The anterior (left lateral) and posterior (right lateral) peristomal delimitations are more clearly indicated in sagittal section of the protozoan (figs. 16 and 17). The posterior peristomal lip sinks from the ventral surface in an anterodorsal direction through about two-thirds of the cell thickness, then bends sharply antero-ventrad to approximately its original level where it unites the rolling flange of the crest.

The sac-like *cytopharynx* is a direct posterior continuation of the wall of the peristome, through the cytostome, into the endosarc.

The *cytoplasm* is finely granular and is slightly denser in some regions which in the living ciliate and in the majority of fixed and stained preparations are located in the middle of the cell. However, a chromate fixative, which need contain no osmic acid, may partially oxidize fatty substances in the cytoplasm just beneath the cell surface, and invest them with the property of forming a " lake " with hæmatoxylin (Microtomist's " Vade-Mecum," 9th ed., p. 463) during staining procedure, thus rendering them insoluble in the ordinary fat solvents employed during dehydration and clearing. This reaction occurs infrequently, but uniformly throughout a given set of slides, when Allen's B-15 is used as the fixing fluid (fig. 11).

The tendency for fatty substances to collect at a cell surface is indicated by the phenomena of surface tension reduction (Gibbs-Thomas Law). And, as a result of the action of the chromic acid, certain of the fatty substances of this protozoan appear as irregular, ovate granules of about 1μ–$1{\cdot}5\mu$ diameter, which are arranged in definite longitudinal rows at the surface, being uniformly distributed between the ciliary rows (figs. 11 and 12). These granules which appeared rarely, depending upon the action of the chromate, are not to be confused with the small algæ or bacteria which are sometimes ingested in enormous numbers by the ciliate.

Lynch (1930) mentions the occurrence of glistening granules of from $1{\cdot}5\mu$ to 3μ diameter in the cytoplasm of living specimens of *Lechriopyla mystax* (from *Strogylocentrotus*), which he concludes are fatty of nature. They failed to appear in his sectioned material, being destroyed during the technical procedure ; he makes no mention of their surface or longitudinal arrangement.

The longitudinal arrangement of these fat granules would seem to indicate that perhaps by their presence the longitudinal ciliary fibres or the myonemata tend to confine these globules which are inclined to aggregate at the surface within the spaces among the rows of cilia. A transverse section of the ciliate, likewise, shows the surface cytoplasm to be thrown into folds or corrugations, the cilia and basal granules being imbedded in the depressed regions (figs. 16 and 17).

The arrangement of these fatty substances is of interest in connection with similar orientation of mitochondria in certain infusoria, as described by Horning (1927*a* and 1927*b*). He points out that mitochondria due to their

possible phosphotidal and fatty acid nature (Mayer, Rathery, and Schæffer, 1914) probably collect at the cell surface like other fatty substances. At the cell surface they are relegated to longitudinal bands demarcated by the myonemata.

Unfortunately the Bermuda material at present available does not afford suitable preparations for a study of the mitochondria.

Three spherical *contractile vacuoles* are present ; two are laterally placed on opposite sides, and the third is near the posterior end. Food vacuoles are numerous and are generally limited to the region posterior to the macronucleus. The majority of them lie within the limits of a region bounded by the posterior curved portion of the pharyngeal fibre, which will be discussed later in connection with a consideration of the neuromotor apparatus. The anal opening is at the posterior end.

Macronucleus.—Considerable variation occurs in the shape of the macronucleus, which may grade from a more common roughly spherical form through an ovate shape to one which is practically pyriform. The latter shape may possibly indicate the recent occurrence of fission. The macronucleus varies from 19μ to 35μ in diameter. It is embedded centrally in the cytoplasm just posterior to the transverse portion of the peristomal groove. As has been noted, the ventral supra-nuclear cytoplasmic region is notably distended.

In general, the macronucleus is uniformly granular ; it stains so intensely that its details are obscured. However, there are frequently observed in it globular condensations resembling those noted by the author in the macronucleus of *Balantidium* (Scott, 1927). The macronucleus is positive in its thymonucleic acid reaction to the Feulgen test.

Micronucleus.—The spherical micronucleus is about 4μ–$4{\cdot}5\mu$ in diameter. It lies close to the macronucleus, more commonly on the left side of it. Frequently it migrates to a position anterior to the macronucleus, lying within the cytoplasm of the crest.

Neuromotor System.

The structure of the neuromotor system of *Metopus circumlabens* is such that its individual parts may be observed with little difficulty. Their possible integration and function in relation to cellular activities, however, is largely a matter of interpretation. The neuromotor system in this protozoan consists of (1) the peristomal membranelles, (2) motorium, (3) ventral and dorsal adoral fibres, (4) pharyngeal strand, and (5) the peripheral cilia.

The *peristomal membranelles* are definitely limited in their distribution to the posterior (lower), peristomal lip, which owing to the curvature of the peristomal trough becomes the left lateral peristomal surface. The membranelles arise from well-developed parallel rows of basal bodies set in a

ventro-dorsal axis. Upon fixation the membranelles are resolved into discrete cilia, each about 7μ in length. At the entrance of the peristome, the rows of membranelles attain their greatest breadth and spread upwards over the dorsal peristomal wall (fig. 15) until at this region the entire concave surface is covered with long, closely packed membranelles. Within this peripheral concavity of the peristome, the membranelles arrange themselves so as to extend outward in brush-like form (pl. I) from the crescentric depression below the tip of the crest. At the opposite end of the peristome the membranelles extend well into the cytopharyngeal depression.

Motorium.—In *Metopus* a centre whence various peristomal fibres arise may well be considered as a motorium. This conclusion is based upon the structure, position, and staining reaction of this organelle in *Metopus*, as well as upon the conclusions presented by several previous authors. The motorium lies deeply embedded in the cytoplasm posterior to the cytostome (figs. 1 and 13). By itself the motorium proper might be considered triangular in shape; however, the branching fibres arise from it so gradually that its individual identity is obscured. It is a highly chromophilic structure, staining intensely with fuchsin in Mallory's triple-colour stain.

Three sets of fibres arise from the motorium:

(1) *Ventral Adoral Fibres.*—A pair of large fibres, with regular strong connections between them, arise from the motorium upon its left side. They lie within the superficial cytoplasm and follow the peristomal curvature outward to the oral margin, where they end in a sort of arborization resembling in structure the "furcula" of *Lechriopyla mystax* (Lynch, 1930). The peripheral arborization of these adoral fibres terminates within the field of the peripheral peristomal membranelles. Each row of peristomal membranelles arises immediately in contact with a connective between these two fibres (fig. 17).

(2) *Dorsal Adoral Fibre.*—A heavy short fibre arises from the right side of the motorium, curving slightly dorsad and then directly anteriad. It extends along the dorso-lateral wall of the peristome, but does not extend into the crest. At times the dorsal adoral fibre appears double; this is caused by a fold in the peristome parallel to it, which extends upward and becomes a part of the crest. At slightly irregular intervals it gives rise to heavy connective fibres, which may partially fuse in pairs as they curve beneath the dorsal wall of the peristome to its left side, where they turn ventrad and unite with the ventral adoral fibres (figs. 1, 3, and 17). These branches vary in number from ten to twelve. The several large cilia (undulating membrane ?) described later arise from this dorsal adoral fibre as seen in cross-section (fig. 17).

(3) *Pharyngeal Strand.*—A very striking pharyngeal strand arises from the posterior end of the motorium (figs. 1 and 13). It shows considerable variation in the direction which it takes through the cytoplasm. In the majority of individuals, however, it courses posteriad along the right lateral wall of the cell—to the right of the cytopharynx—well into its posterior end

where it forms a large spiral coil. The strand is thickest at its origin, gradually becoming more and more attenuated.

The pharyngeal strand of *Metopus* is fibrillar in nature ; the majority of the individual fibrils originating directly from the motorium, some few additional ones being contributed from the left side at a lower level, pass around from the walls of the cytopharynx. The longest fibrils extend to form the spiral coil and frequently some fibrils isolate themselves from the main strand each forming its own coil.

Structures which approach in resemblance the pharyngeal strand of *Metopus* have been described in numerous ciliates under various names. Higgins (1929) has described a " sub-pharyngeal canal " in *Nyctotherns*, which she suggests is a tube and may be an avenue for the conduction of fluid waste from the pharyngeal region toward the contractile vacuole. The present author has no evidence that the pharyngeal strand of *Metopus* is tubular in nature, but to the contrary, as seen in cross-section, is composed of fibrils which are so distinct that they separate out from the main strand as is already indicated. Frequently there is considerable interfibrillar space which stains more lightly than the fibrils themselves. *Boveria teredinidi* (Pickard, 1927) shows a " pharyngeal fibre " which is a continuation of the anterior adoral fibre and receives a contributing fibre from the oral ring ; it passes " following the area occupied by the pharynx during the ingestion of food," makes a dexiotropic spiral around the potential gullet, and extends very close to the anterior end of the macronucleus without, however, establishing any connection with it. Pickard (p. 409) suggests that possibly this ciliate " has lost its undulating membrane in the mouth and that this structure is represented only by this persistent fibre of the neuromotor system in the pharynx." *Dallasia frontata* (Calkins and Bowling, 1929) has two very delicate fibres which run from the motorium deep into endoplasm, where they are lost, one in the vicinity of the macronucleus, the other in the vicinity of the contractile vacuole. *Lechriopyla mystax* (Lynch, 1930) has a " pellicular fibre " which arises from the left end of the internal cytopharyngeal opening. *Eupoterion pernix* (MacLennan and Connell, 1931) shows a " pharyngeal strand " which is a continuation of fibrils lining the cytopharynx, one of these being a continuation of the transverse fibril from the motorium, a more direct connection with the neuro-motorium than described by Pickard in *Boveria teredinidi*. MacLennan and Connel conclude that its function may be a reinforcement of the pharyngeal wall. The pharyngeal strand of *Conchophthirius mytili* (Kidder, 1933) more nearly resembles that of *Metopus*, perhaps, than that of any other species hitherto described, since it arises directly from the motorium and continues into the endoplasm. Although no common function has been suggested for these strands, it is worthy of notice that because such a strand serves to allocate a track of fibres from the anterior neuromotor system to the central endoplasmic region of the cell and especially into the vacuolar region, that through this track neuroid transmission may conceivably activate or retard

anterior ingestatory ciliary responses according to the predominance of intra- or extra-cellular conditions. It is, of course, entirely probable that, in addition, this fibrillar strand may serve as a mechanical support to the cell as well as a possible postero-dorsal guide for food particles issuing from the cytopharynx.

Physiological studies made upon *Metopus* along with three other ciliates of *Diadema* (Jacobs, 1914) demonstrate that " the physiological characters of an organism are not merely the result of its environment, but may be as fundamental and characteristic as its morphological ones." The individual reactions of *Metopus* indicated a superior resistance on its part to environmental conditions to which it was experimentally subjected. These experiments of Jacobs show that *Metopus* is in the majority of cases the most resistant to lethal effects of unfavourable experimental conditions. For example, *Metopus*, when compared with its three co-existent ciliates, was 900 times as resistant to H_2SO_4, eight to ten times as resistant to H_2S, lived ten to twenty times longer in sea water, lived longest or next to longest in CO_2 and KOH. Physiologically this is interesting; we cannot, however, from so limited evidence, infer that the existence of an individual neurological specialization within the *Metopus* cell is sufficiently important functionally to exercise control over the permeability of the protozoan cell. Jacobs also determined that both in decomposition products and the well-known injurious sea-urchin body fluid *Metopus* was the most quickly, or next to the most quickly of the several ciliates affected. These results may have been due to the presence of enzymes which destroyed the protozoan's cellular resistance to these two media. In any event the resistance of this cell is quickly and to a greater extent destroyed by decomposition products than that of certain other protozoa from the same environment; but *Metopus* has a vastly greater resistance than any of the other ciliates used to chemical substances introduced into its environment.

Peripheral Ciliation.—Practically the entire cell body except the right lateral margin is covered with rows of cilia. The longest cilia occur upon the anterior cell margin and upon the peristomal lip. The dorsal surface of the peristome as well as the upper lip are both devoid of ciliary structures. Several large, strong cilia (flagella ?) are present upon the right lateral surface of the peristome in the cytostomal region as seen in a study of cross-sections (pl. IV, fig. 17). This series of structures has been interpreted by some authors to represent an undulating membrane. They are to be distinguished from the peristomal membranelles (*see* neuromotor system) in whole amounts only by their greater tenacity for hæmatoxylin stain and by their slightly coarser nature.

The remaining body cilia in general decrease in length towards the posterior end, where a tuft of about twelve long cilia occurs. The cilia of fixed and stained specimens lie in various directions, showing no regular or alternate parting of the individual cilia such as has been reported for some ciliates. Longitudinal ciliary fibres are present.

Exclusive of the cilia upon the crest *Metopus* has about thirty-two rows of body cilia which originate at points slightly removed from the posterior peristomal lip. The median ciliary rows of the *ventral surface* are equidistant from each other and curve gradually from their point of origin, just posterior to the lower (posterior) peristomal lip, towards the right cell margin as they proceed posteriad (pl. I). The positions of these rows of cilia among the rows of chromophilic granules are indicated in fig. 11. The left lateral rows are only slightly more crowded, and are continuous with the dorsal cilia, while the remaining rows, upon the right side, are markedly crowded, each in turn starting from a more anterior point.

The ciliation of the crest consists of five very closely arranged rows of long (10μ) cilia with large basal bodies and well-developed rootlets. The rows are so closely aligned as to give the impression of a ciliary band when viewed from an anterior aspect (fig. 18); they originate at the left end of the crest just underneath the curvature of its tip and surmount its margin, curving ventrad as they follow the contour of the crest to the right cell boundary. Here, on the ventral surface about one-third of the way along the longitudinal axis of the ciliate, these rows of cilia end in most individuals (fig. 1). In some individuals, however, the three rows nearest the peristome converge slightly and the remaining two rows approach each other closely and in some cases are continuous with the last two right lateral rows of ventral cilia. When viewed in sagittal section an intracellular subciliary zone is apparent beneath these five rows of crest cilia (fig. 16). In living animals these cilia are so co-ordinated in their action as to give five or more large ciliary waves.

The *dorsal ciliary rows* are greater in number than the ventral ones, and, as a result, are more closely arranged; they radiate from an area on the dorsal side about opposite the peristomal groove. They are practically equidistant ($3{\cdot}1\mu$–5μ) in the anterior region and extend posteriad with indistinct (gradual) convergence. The position of the dorsal ciliary rows is clearly indicated by the longitudinal rows of cytoplasmic granules shown in fig. 12.

Longitudinal ciliary fibres are present beneath the body cilia; commissural or connective fibrils, however, seem to be lacking. Numerous fine fibrils arise from the ventral adoral fibres already described and extend vaguely into the cytoplasm towards the longitudinal ciliary rows of the ventral surface (fig. 19), and may be seen in the photograph (fig. 13) extending posteriorly as fine lines from near the oral end of the cytostome. Each basal body in the most dorsal of the five rows of crest cilia gives rise to a similar fibre which extends into the dorsal cytoplasm (fig. 18).

Consequently, as far as peripheral or *motor fibrillar* structures go, *Metopus* displays rather an indistinct but well-integrated organization of fine fibrils which do not arise in direct contact with the motorium itself, but rather as fine branches from the peristomal and adoral fibres. In view of the contrastingly striking and obvious specialization in the fibrillar structure of the neuromotor system about the peristomal, pharyngeal, and central endo-

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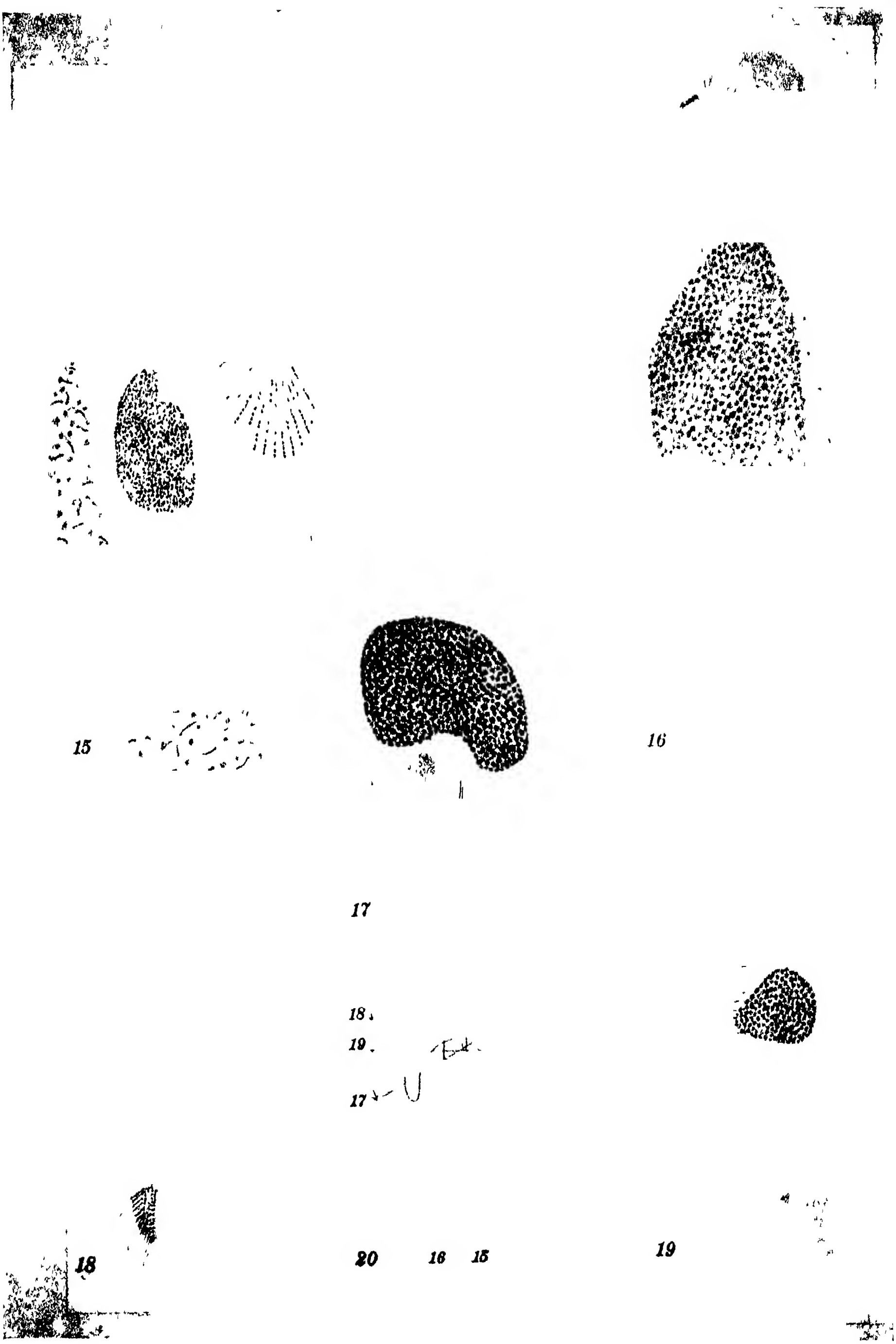
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plasmic regions of the cell, one is inclined to believe that the neuromotor system of this ciliate is vitally, though not exclusively, concerned in the *conductile* functions related to the metabolic activities of the organism. It is possible that, because they are located within the mobile cytoplasm of the protozoan, the stouter of these various fibres may serve in addition some function in the nature of support.

Discussion of the probable supportive and conductile functions of these fibres in relation to ingestion of food has been advanced by several workers. To the morphology of this system of specialized oral and pharyngeal fibres *Metopus* contributes an especially well-developed pharyngeal strand, which, arising directly from the neuromotor system proper, becomes its most outstanding member by establishing intimate continuity with the central endoplasm, where are formed the numerous food and excretory vacuoles so vitally concerned with the metabolic activities of the cell.

In the absence, therefore, of experimental data upon the neuromotor system of *Metopus* and basing conclusions on the study of a great number of living and fixed individuals of this ciliate, the author is at present disposed to believe that the neuromotor system of *Metopus circumlabens* bears a specialized relationship to the ingestatory cilia and to the cytoplasmic mass of the cell including the digestive, absorptive, and excretory organelles.

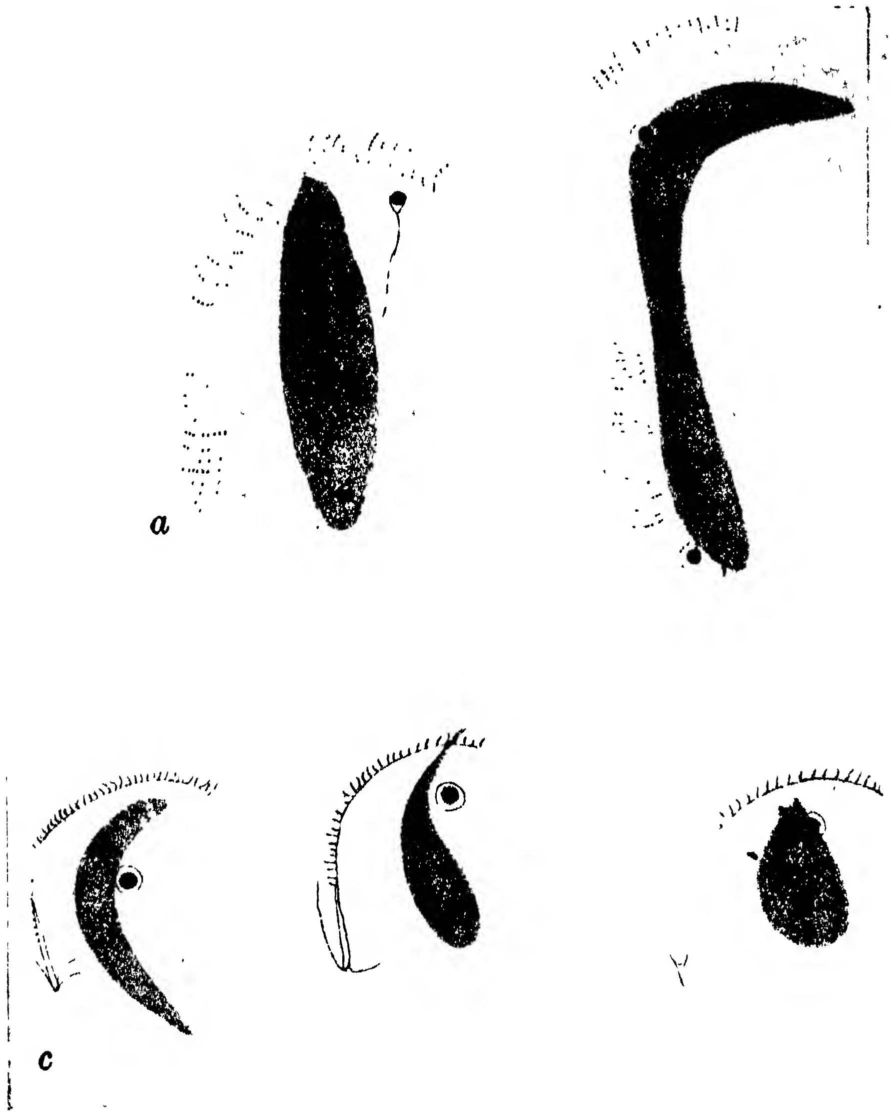
Fission.

Fission stages observed in several individuals indicate that in this protozoan the process follows the usual course of ciliate division, i.e., division in a transverse plane. Text-fig. 1, *a* to *e*, shows certain features worthy of mention in the process.

During the fission process neither of the cells portrays very striking resemblance to the adult *Metopus*. The crest and peristomal groove disappear at the onset of fission (text-fig. 1, *a*). Early in the process a new set of membranelle basal bodies arises in the posterior cell region seemingly in continuity with the old set which has remained intact (text-fig. 1, *a*), but which has been drawn backward upon the aboral cell margin. The micronucleus in this figure has divided and bears a part of the intradesmose still attached. During fission the two sets of membranelle basal bodies are drawn apart as the daughter-cells assume more nearly the typical curvature of the aboral margin (text-fig. 1, *b*) and come to lie finally upon the anterior region of the ventral cell surface.

Observation of the limited number of fission stages available indicates that the neuromotor fibres arise as outgrowths from a clump of specialized posterior basal granules of the membranelle zone (the future motorium ?) (text-fig. 1, *c*, *d*, and *e*). The adoral fibres are already formed in these stages. The ventral ones are double for part of their length shown. The pharyngeal strand is shown in three successive stages of its outgrowth : in fig. *c* it appears as separate fibres arising below the ventral adoral fibres ;

in fig. *d* the fibres are combined into one strand which has increased in length (fig. *e*).



Text-fig. 1.—Outline drawings of the neuromotor system of *Metopus circumlabens* during certain fission stages.

A great number of fission stages is needed to furnish accurate details of the process in this ciliate. The reorganization of the neuromotor apparatus following fission should prove most enlightening in the matter of its structure in relation to its origin.

Metopus rotundus n.sp.

Three specimens of *Diadema setosum* examined carried only a large, round, seemingly distinct species of *Metopus*. Since one of the chief distinguishing characters of this species is its rotund shape, the name suggested is *Metopus rotundus*.

Metopus rotundus n.sp. ranges from 150μ to 250μ in length and from 123μ to 200μ in breadth. Measurements were made upon fixed material. This species is distinguishable from *Metopus circumlabens* primarily in its size and shape (figs. 9 and 10). The posterior end of *Metopus rotundus* does not taper ; the long caudal cilia extend directly from the round cell surface. The posterior peripheral outline of this species, therefore, is almost circular. The same general outline is carried forward except for this interruption of the crest, which in this species lies upon the left lateral cell surface more closely, thus narrowing the peristomal depression at this point, and also making it more shallow than in *Metopus circumlabens*. The body cilia are more numerous and the rows more closely arranged in *Metopus rotundus* than in *Metopus circumlabens* ; as may be seen along the lower margin of fig. 10, they converge to a much less extent in the posterior region. The micronucleus is somewhat smaller in relation to the macronucleus than *Metopus circumlabens* ; it is surrounded by a " halo " and is applied closely against the macronucleus. The dorsal adoral fibre extends forward well into the anterior end (fig. 10), while in *M. circumlabens* it does not enter the crest (fig. 13). This fibre frequently appears to be double, an appearance caused as in *M. circumlabens* by a fold of the peristome. Although larger in *M rotundus* the neuromotor system otherwise duplicates that of *M. circumlabens*. The pharyngeal strand is present, but, due, perhaps, to the thickness of the cell, is not as clearly defined in this species ; it can be seen, however, in its initial direction, curvature and terminal coils.

Summary.

1. Practically 100 p.c. of the adult sea urchin, *Diadema setosum*, are infested with *Metopus circumlabens* ; the same ciliate occurs rarely in *Echinometris subangularis*. A second species, *Metopus rotundus* n.sp., was found in a few specimens of *D. setosum*. *M. circumlabens* is decidedly polymorphic, but present observations do not warrant distinct species segregation.

2. *M. circumlabens* averages 95μ in length and 58μ in breadth ; *M. rotundus* n.sp. ranges from 150μ to 250μ in length and from 123μ to 200μ in breadth.

3. General cytological features of *M. circumlabens* are noted together with a detailed discussion of the neuromotor system.

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EXPLANATION OF PLATES.

PLATES I, II, III, and IV.

PLATE I.

FIG. 1.—Composite drawing to demonstrate general morphological features of *Metopus*, especially *Metopus circumlabens*.

PLATE II.

Photomicrographs of smears × 435.

FIGS. 2–5 inclusive—Photographs of *Metopus circumlabens* to indicate range of variation in cell shape. Figs. 4 and 5, dorsal view. Schaudinn's fluid.

Figs. 6 and 7.—Variations seen in material fixed in Allen's B-15 modification of Bouin's fluid. Fig. 7, ventral view

Fig. 8.—An individual resembling that in Fig. 7, but fixed in vom Rath's fluid.

Figs. 9 and 10.—Dorsal view of *Metopus rotundus* n.sp.

PLATE III.

Photomicrographs × 850.

Fig. 11.—Ventral view of *Metopus circumlabens*, photographed at high level to show chromated granules thrown into definite ridges between the ciliary rows.

Fig. 12.—Dorsal view, showing the same arrangement.

Fig. 13.—Ventral view of *Metopus circumlabens* photographed to show cytostomal lip, on reader's left, with dorsal adoral fibre showing through the dorsal cytostomal wall. Motorium and pharyngeal strand fibre also are shown in the interior. Several ventral cytoplasmic fibrils are seen (on reader's right) arising from the basal bodies of the peristomal membranelles.

Fig. 14.—Dorsal view, showing origin of the paired ventral adoral fibres and peristomal strand from the motorium.

PLATE IV.

× 1300.

Camera lucida outlines. Fig 20 shows the planes of sectioning; arrows indicate the observer's axis of vision.

Fig. 15.—Lateral view of sagittal section shows the basal bodies of the peristomal membranelles. Some fibrils arising from the basal bodies of the crest cilia are visible.

Fig. 16.—Lateral view of sagittal section. Dorsal ciliary rows and the band of five ciliary rows upon the crest are shown in cross-section. The peristomal membranelles and the two ventral adoral fibres also appear in cross-section.

Fig. 17.—A transverse section showing the peristomal organization. The dorsal adoral fibre and one connective are shown. One long cilium (undulating membrane ?) is seen arising from the dorsal adoral fibre. The paired ventral adoral fibres show in cross-section.

Fig. 18.—A transverse section near the surface of the anterior end showing the ciliated band on the crest, and the dorsal cytoplasmic fibres departing from it.

Fig. 19.—Transverse section showing ventral cytoplasmic fibres originating from the basal bodies of the peristomal membranelles.

AUTHOR'S ABSTRACT.

Two species of the genus *Metopus* (*M. circumlabens* Biggar and *M. rotundus* n sp.) occur among other ciliates in the intestinal lumina of Bermuda Island sea urchins. *M. circumlabens* has formed the basis for a cytological study of the neuromotor system. The pharyngeal strand which in *Metopus* has reached a prominent state of development is perhaps the element most suggestive of theoretical consideration.

578. 65. VII.—MODIFIED WEIGERT-PAL AND BIELSCHOWSKY TECHNIQUES FOR CLASS PURPOSES

By F. Haynes, M.A.

(From the Harvey Laboratory, St. Bartholomew's Hospital, London.)

(*Read April 18th*, 1934.)

Practical experience has shown that none of the published methods for staining medullary sheaths or neurofibrils in the central nervous system can be relied upon for constant results such as are required for class purposes. It has been found, on the other hand, that the following techniques may be depended upon to supply not only a few sections, but numbers sufficient for a class of a hundred or more students.

For either technique, human brains and spinal cords are obtained from the post-mortem room and kept in 10 p.c. formol until required. By formol is meant the 38–40 p.c. formaldehyde supplied commercially. Frozen sections are cut, their thickness depending on the technique to be adopted, those for the Weigert-Pal method being best cut at about 20μ, while those for the Bielschowsky method may be from 6μ to 15μ or even more. From then onwards, the treatment is as follows:

Weigert-Pal Technique for Medullated Nerve Fibres.

1. Mordant for 24–36 hours at room temperature in the primary mordant:

Potassium bichromate	5 grammes
Fluorchrome	2·5 grammes
Water	100 c.c.

The darkness of the eventual stain is largely dependent on the length of this treatment.

2. After rinsing well in distilled water, place for 2–3 hours at room temperature in the secondary mordant:

Fluorchrome	2·5 grammes
Copper acetate	5 grammes
Glacial acetic acid	3 c.c.
Water	100 c.c.

3. After rinsing in several changes of distilled water, stain for 48 hours at room temperature in

10 p.c. absolute alcoholic solution of hæmatoxylin	..	10 c.c.
Saturated watery solution of lithium carbonate ..	..	2 c.c.
Water	..	100 c.c.

All the above-mentioned solutions should be freshly prepared.

4. Rinse thoroughly in many changes of distilled water. If the sections are given out to the class they are handed out in distilled water at this stage. If it be necessary to keep the sections for more than a few days before they are handed out it is well to add a few drops of formol to the vessel to inhibit the growth of moulds or bacteria. If this be done it is necessary to give the sections a bath of clean distilled water afterwards.

5. Oxidize the stain for 1–3 minutes with 0·25 p.c. potassium permanganate in 1 p.c. sulphuric acid solution.

6. Transfer direct to 2 p.c. sulphurous acid solution until section is blue-black. The sulphurous acid solution is conveniently prepared by mixing equal volumes of 4 p.c. potassium sulphite and 4 p.c. oxalic acid. It is essential that no tap-water shall come in contact with the sections after they are cut, otherwise calcium oxalate crystals will be formed in the substance of the section.

7. Rinse thoroughly in distilled water.

8. Repeat steps 5, 6, and 7 until the grey matter is colourless and the white matter deeply stained. The oxidizing and reducing solutions must be changed frequently.

9. Float the section on to a slide and blot dry with filter paper, using a fair degree of pressure.

10. Dip the slide gently into a tube of absolute alcohol for ½ minute, clear in xylol and mount in balsam.

Bielschowsky Technique for Neuro-fibrils.

1. Remove all traces of formol either by repeated washings in distilled water or by an initial bath of slightly ammoniacal distilled water followed by plain distilled water.

2. Place the sections in 4 p.c. silver nitrate at 37° C. for 30–60 minutes.

3. Rinse well in distilled water.

4. Place in ammoniacal silver solution for 2–5 minutes.

This solution is best prepared as follows, and should be freshly prepared unless kept in a dark glass bottle, well filled and tightly closed.

A 20 p.c. solution of silver nitrate is precipitated with concentrated ammonia and the precipitate redissolved in the minimal additional amount of ammonia. There should be no excess of ammonia, and it may be well to cease adding ammonia while there is still a little undissolved precipitate.

Then filter. In either case, dilute the solution by the addition of three to four volumes of distilled water.

5. After rinsing well in distilled water, reduce in slightly alkaline 4 p.c. formol. The reduction must be thorough, and while it may be complete in 5 minutes it is best to leave the sections in the solution for 15–20 minutes.

6. Rinse carefully in distilled water, and tone thoroughly in equal parts of 0·1 p.c. gold chloride solution in distilled water and saturated watery solution of lithium carbonate.

7. Wash in distilled water and reduce for 5–10 minutes in 5 p.c. sodium thiosulphate.

8. Wash well, float section on to slide and blot dry, using a fair degree of pressure.

9. Dip the slide into a tube of absolute alcohol for ½ minute, clear in xylol and mount in balsam.

If the sections are given out for mounting by the class they are handed out in distilled water after stage 7.

In neither of these techniques should the sections be handled with metal instruments. Glass section-lifters are the best, but a useful substitute is to be found in a wedge-shaped strip from a visiting card.

VIII.—A LOW-POWER MICRO-PROJECTION APPARATUS. **778. 31.**

By H. J. Wilkinson.

One Text-Figure.

In practical classes, e.g., of neurology, embryology, and histology, and in many branches of research, the need often arises for an apparatus which will project microscopic sections of 1 inch or 1½ inch diameter, so as to give images with magnifications of from 4 × to 8 ×, so that drawings can be made quickly and easily. Many forms of apparatus are procurable which will project sections for drawing, but many, at the most, will project only ½-inch circles or less, and most of them are very expensive.

To provide a suitable inexpensive apparatus which could be used, among others, by students in an ordinary class-room, it was found that the desired result could be obtained by adapting an old camera, as shown in the accompanying figure. The camera is screwed on to a board so that the focusing screw projects out over the edge. A board was made of the same dimensions and construction as those of the plate carrier. This had an aperture of suitable size cut in its centre, and was fitted with ordinary microscope clips, as shown, to hold the slide in position.

As a source of illumination any of the " point-source " types of bulb will do, such as a point-o-lite, a bulb with a band element or a closely wound spiral filament, and an arc lamp. This is used in conjunction with a condenser of about 1½-inch focus. The light should be covered. This can be done by fitting it into a ventilated can. Many laboratories will no doubt have a photomicrographic lamp with lamp-house and condenser all in one fitted to a stand. The apparatus illustrated is by Leitz and has the lamp-house fitted with a focusing condenser (f = about 1½ inch). Most of the optical companies such as Zeiss, Beck, Bausch and Lomb, etc., offer similar equipment. The Leitz micro-lamp is fitted with a Phillips' 6-volt 4-amp. bulb with a closely wound filament. The apparatus by Bausch and Lomb has a band element, and that by Beck has a Phillips' point-o-lite. Most of the bulbs require a suitable resistance if connected up with the electric light circuit.

The drawing board is fixed in a vertical position at a suitable distance (about 4 feet) from the camera. A mirror at an angle of 45 degrees to the optical axis can be placed between the camera and the drawing board so that the latter can be fixed in a horizontal position, but in practice it will be found that the position as illustrated has advantages, not the least

important of which is that the whole apparatus can be readily carried about as a unit or moved and bumped without fear of disturbing the optical conditions.

Under these conditions a camera lens of about 7½-inch focus gives a magnification of a little more than 4 ×. In order to get greater magnifications, a set of simple biconvex lens, obtainable at any optician's and ranging from 0·50 to 4 dioptres can be slipped into a simple holder fixed in front of the camera lens. With a lens of 1 dioptre a magnification of about 5¼ × is obtained, and this was found to be very suitable, e.g., for drawing Weigert-Pal sections of the brain stem. The illustration shows the projection, on foolscap, of a section of the brain stem taken from the mid-olivary region.

Such an apparatus is fool-proof and saves the student much time which can be better given to more important detail work. Also in the drawing of any particular set of sections, all can be drawn to the same scale.

Besides the class work, the apparatus is particularly useful in neurological research, for quantitative estimations of areas of degeneration; but

Fig. 1.

the suitability of the apparatus will at once suggest itself to workers in different fields.

To adjust the apparatus, first arrange the filament, the condenser, the microscopic slide, and the camera lens all, as near as possible, in the one optical axis parallel to the bench. Switch on the light and illuminate the section. Then focus the microscopic section on the drawing paper by means of the focusing screw of the camera. Now adjust the condenser so that an image of the filament is seen on the slide, then gradually move the condenser away from the filament and the area of the slide which is illuminated will gradually increase. Move the condenser until the whole section is well illuminated. It is quite probable that minor adjustments will be necessary owing to the fact that all parts are not in the true optical axis. This can now readily be accomplished and the apparatus is ready for use, and can be left set up as a more or less permanent equipment. All that students will now have to do is to switch on the light, and set their slides and paper in position, and this can be done without the necessity of interfering with the finer adjustments.

IX.—*EUDORINA ELEGANS*, EHRENBERG, *FORMA ELLIPSOIDA*, Sub var. *TUBIFERA*. **581.41.**

By S. C. Akehurst, F.R.M.S.

(*Read February 17th*, 1932.)

Two Plates.

Conrad (1913) in his account of *Eudorina elegans* gives two figures—one showing the form of the outlet trumpets in the gelatinous sheath of this alga, with the pair of cilia passing through one aperture. The second figure is a repetition of the first, with an addition showing a portion of a cell with stigma, indicating that the tube is not in contact with the cell.

It is not necessary to enter into a detailed account of the various interpretations of the relation of aperture to cilia; most of these are recorded in Conrad's paper. Roughly, they resolve themselves into descriptions of canals, with either one or both cilia passing through one or two apertures.

Franzé (1893) states that the cilia lie in one or two tubes, and it is these tubes that remain when the cell has divided several times inside its membrane. There are also accounts by Merton and Chatton. Pascher (1927) reproduces both of Conrad's figures, omitting reference to the cell. This is the most recent record we have been able to trace, showing relation of cilia to the outlet tube or aperture.

There are two forms of *Eudorina*—globose and ellipsoid—but there are differences of opinion as to whether one or both forms exist. West (1904) is emphatic that the specimens he took in this country were globose, and in his " Algæ " (1916) states that there are probably two distinct races—those markedly ellipsoid with posterior lobes, and those without, being almost globose.

Conrad, on the other hand, maintains that he has never seen them really spherical, and is of the opinion that algologists who speak of spherical cœnobia have seen the ellipsoid form from one or other of the poles. He quotes several authors, who speak exclusively of ellipsoid cœnobia.

We have taken both forms from ponds in the London suburbs—the globose from a pond in Kew Botanical Gardens (fig. 11), and the ellipsoid from Cathill Pond, North London.

In the globose form the disposition of the cells (usually thirty-two) into bands is not arranged with such precision as is common in the ellipsoid; also we found no trace of any funnel-shaped processes in this form. The

cœnobia are very varied in size. The cilia of a cell are parallel to the surface of the envelope, and an appreciable distance apart. The mucilage of the sheath is apparently so diffluent that the boundaries of the tubes or canals are not ordinarily well defined.

On our mount of the globose form we have over two hundred cœnobia, but only found three with sixteen cells, and no instance of cell division in any stage. Although completely formed daughter-cœnobia of various sizes can be located, varying from those that have just completed cell division and are not much larger than the original mature gonidial cell, to the fully grown cœnobia, yet we failed to trace cases of young cœnobia developing within the parent envelope. This collection was made in September.

On our mount of the ellipsoid forms (fig. 9) taken from the Cathill pond in April we have about 150 cœnobia. Counting those that came within the field of a 1-inch objective whilst following the rim of the mount, there were forty-one sixteen-celled and only thirty thirty-two-celled cœnobia. Seven only of the sixteen-celled forms were small, and if undisturbed might have again divided.

In the same area ten sixteen-celled and five thirty-two-celled cœnobia were dividing to form daughter-cœnobia. Fig. 17 shows a sixteen-cell cœnobium with some of the cells represented by a quadrangular plate of sixteen cells, cupping to form a new cœnobium. Every stage of cell division from the initial to the final thirty-two cells can be traced. We have no record of sixty-four-celled cœnobia.

In one or two cases oospores are exhibited, also clusters of ciliated spermatozoids. The stigmata are pronounced in the anterior cells, diminishing in size in the intermediate, and difficult to make out in the posterior cells.

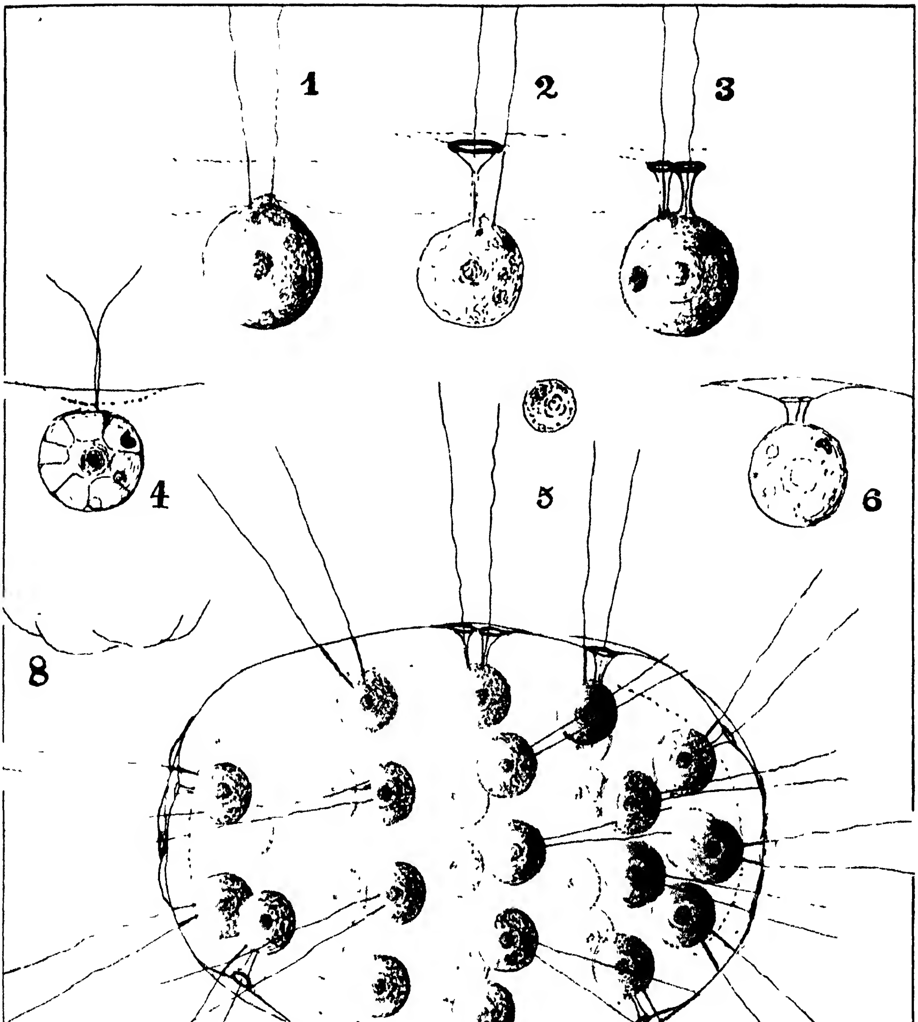
The mammillons on the posterior poles of our specimens are not well defined (fig. 8); often they are too indefinite to be considered as such.

Dwarf cells were noticed indiscriminately mixed with the larger uniform gonidial cells—these occurring in numbers from one to eight (figs. 5 and 18).

The text-books describe *Eudorina* as usually thirty-two-celled cœnobia. As already stated, our collection of the ellipsoid form is about equally divided into sixteen- and thirty-two-celled cœnobia; invariably the sixteen cells are arranged in four bands of four cells each (fig. 10), whilst the thirty-two-celled cœnobia (fig. 7) have five bands—two of four cells each, one in each of the anterior and posterior poles, and three intervening bands of eight cells each.

The changing over from a four-banded to a five-banded cœnobium necessitates a rearrangement of the cells before they can be resolved into five bands—two of four and three of eight cells.

The question arises, have we in the sixteen-celled variety a permanent form, or merely an arrested transition stage of a thirty-two-celled cœnobium? In view of the proportions of the two forms on our slide we cannot describe the cœnobium as usually consisting of thirty-two cells.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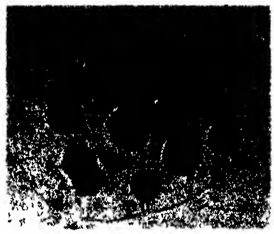

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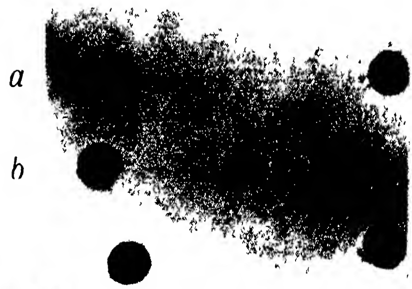

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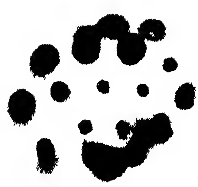

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Kofoid (1898) had constantly in mind the possibility that the form he described—*Pleodorina illinoisensis*—was merely a stage in the life cycle of *Eudorina*. In his gathering the two were associated. We found no forms of *P. illinoisensis* in our Cathill collection. This closely allied form might provide us with some points in agreement with the arrangement of cilia in relation to aperture when compared with our Cathill ellipsoid forms, to be described.

Kofoid states: "The sheath is traversed by the pairs of flagella which arise from the outer ends of each of the cells." Well-defined figures of undivided cells, also of a colony, accompany the text, and these give no indication of either canals or funnel-shaped apertures. These details, coupled with those we have given concerning the indefinite appearance of canals on the globose forms of *Eudorina*, lead to the conclusion that the following details are specific characters of the ellipsoid form only.

Each cilium of a cell passes through an aperture in the gelatinous sheath, and in no instance have we located two cilia lying in one aperture. Each cell may have two canals (fig. 1) as outlets for one pair of cilia—or one canal and one funnel-shaped process, the exit end of which is flanged and has a well-defined collar (fig. 2)—or two funnels (fig. 3). The cilia are not parallel but slightly diverge when issuing from the cell. In figs. 1, 2, 4 and 7, to avoid confusion the canals have been omitted; the funnels only are shown. A constant feature of the gelatinous sheath is the saucer-shaped depressions surrounding the exit end of the funnels (figs. 7 and 10).

The high-power binocular microscope gives binocular vision, but a certain amount of stereoscopic relief can be obtained when using objectives of 1·0 numerical aperture and over. Employing this form of instrument, rather than excessively high magnifications under a monocular microscope, renders differentiation of two tubes lying approximately in the same plane more definite. We found this method of examining our specimens the most useful in determining relation of cilia to outlet apertures.

We desired to support our figures of the details referred to with photomicrographs, and we are indebted to Mr. C. H. Caffyn for a series of photographs without which our figures would be less convincing.

Fig. 12 represents a cell with one only funnel and well-defined collar—as the cilia are apparently superposed, in the photograph it is not definite as to whether one cilium or both emerge from the exit end. Under the microscope, however, one only cilium is clearly seen issuing from the funnel; an adjoining cell exhibits a naked cilium.

Where we have the cell in close contact with the gelatinous sheath through which the outlet aperture passes, and the latter filled with stain, it is conceivable that an incorrect photographic record could be obtained, making the funnel appear as an outgrowth of the cell when it might be otherwise. Contact of the funnel with the cell also required more definite demonstration photographically, as well as the fact that one, and not two, cilia emerge from each aperture.

With advancing age of the cœnobium the sheath deliquesces and gradually disperses. We located a sixteen-celled cœnobium where the sheath has entirely disappeared, leaving the sixteen cells broken up and disarranged. The photograph (fig. 13) exhibits five only of the cells in the field with and without funnels. Two further photographs were taken of individual cells of this group, one showing a pair of naked cilia (fig. 14), the other with funnels, one cilium passing through each (fig. 15).

In another instance we found a mature cœnobium showing considerable expansion of the sheath. At the points in contact with the funnels the sheath is held down. From funnel to funnel the sheath bulges to such an extent as to produce a scalloped appearance (fig. 16). This appears to provide confirming evidence that the funnel is part of the cell structure—if we were dealing with a canal only, uniform expansion of the sheath would be looked for.

It was our desire to continue investigation on living specimens, and thus avoid any confusion that might arise from observation on stained forms. This unfortunately was not possible.

We have figured one instance only of funnels on a young cell in the living alga (fig. 6). We therefore put forward our records tentatively; they appear, however, to present a correct interpretation of observed facts.

The form described will be known as *Eudorina elegans forma ellipsoida*, sub var. *tubifera*.

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EXPLANATION OF FIGURES.

Figs. 1–8 are from drawings representing details of the ellipsoid form with funnels.
Fig. 1.—A cell having two naked cilia.
Fig. 2.—A cell having one naked cilium and one contained in a funnel.
Fig. 3.—A cell with the two cilia each in a funnel.
Fig. 4.—Cell forming a colony.
Fig. 5.—A dwarf cell.
Fig. 6—A cell from a living colony, showing the funnels present.
Fig. 7.—thirty-two-celled cœnobium, showing arrangement of cells and presence or absence of funnels.
Fig. 8.—Mammillons at posterior pole of colony.

Fig. 9.—× 58. Sixteen- and thirty-two-celled cœnobia of the ellipsoid form from Cathill Pond.

Fig. 10.—× 375. Sixteen-celled cœnobium, four bands of four cells each. The stain (methylene blue) shows the cells with funnels.

Fig. 11.—× 160. Colony of *Eudorina elegans Forma Globosa* from pond in Kew Botanical Gardens.

Fig. 12.—× 830. Cell with one only funnel-shaped process, one cilium emerging from the funnel, the other cilium behind. The adjoining cell shows one naked cilium.

Fig. 13.—× 370. Group of five cells from a broken up cœnobium of sixteen cells. The gelatinous sheath is dispersed. Some cells show naked cilia, other cilia with funnels intact.

Fig. 14.—× 1255. Higher power photograph of one cell (*b*) from the group of five in fig. 13. It exhibits a pair of naked cilia.

Fig. 15. × 1255. Another cell (*a*) from the group in fig. 13, showing two funnels each with its own cilium.

Fig. 16.—× 300. Gelatinous expanding sheath held down at points in contact with funnels.

Fig 17 —× 300 Sixteen-celled cœnobium ; some cells not dividing, others quadrangular sixteen-cell plates slightly cupping to form new cœnobia.

Fig 18.—× 300. Cœnobium exhibiting eight dwarf cells. These cells occur in varying numbers from one to eight in a colony.

X.—CHROMOSOME STUDIES IN ALLIUM.

II. The Meiotic Chromosomes.*

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(Professor of Botany, Trivandrum, Travancore.)

(*Read April 18th*, 1934.)

One Text-Figure and Two Plates.

I. Introduction.

The writer undertook a detailed investigation of the chromosome structure and division in several species of *Allium* at the Botanical Department of the King's College, London, in September, 1932, following rather interrupted earlier observations at Trivandrum, S. India. As the work progressed, evidences of a pair of persistent twisted threads which showed a regularity in the mode of twisting in each chromosome became apparent. A preliminary note was published in *Nature* (Koshy, 1933a) calling attention to these structural peculiarities of *Allium* chromosomes. A subsequent publication (Koshy, 1933b) has embodied a detailed account of the structure and division of the somatic chromosomes in four species of *Allium*. The dual threads of each chromosome were observed to persist as intertwined structures, and it was shown that the so-called alveolar and chromomeric appearances of chromosomes are merely misinterpreted images of the double coils under different degrees of expansion and contraction to which they are subjected in the mitotic cycle. The cleavage, which takes a spiral course in each chromosome, is observed to be initiated at the late prophase of the previous division. At the metaphase, the quadruple threads of each chromosome separate in pairs by a process of unwinding. It is also observed that the twisting or coiling of the two chromonemata of each chromosome is in opposite directions in its two arms, the point of reversal of direction corresponding to the attachment constriction of the chromosome.

The behaviour of chromosomes during the meiotic divisions being inseparable from their structure, the investigation was continued with a view to finding out the extent to which the above view of chromosome structure is applicable in meiosis. The present paper deals with the structure and behaviour of the meiotic chromosomes in twelve species of *Allium*.

* Thesis (in part) approved for the degree of Doctor of Philosophy in the University of London.

II. Material and Methods.

Material for the present study was obtained through the courtesy of the Experimental Station of Messrs. Sutton and Sons, at Reading, and the authorities of the Chelsea Physic Garden.

Flower buds of *A. porrum* var. Sutton's Prize-taker and *A. Cepa* var. Sutton's Globe Onion, in various stages of development, were fixed at Reading in the following fluids :

(1) Flemming's medium fluid.
(2) La Cour's fluid 2B.
(3) Navashin's fluid.
(4) Improved Carnoy's fluid.

A previous treatment for a few seconds in Carnoy's mixture (absolute alcohol 6, chloroform 3, and glacial acetic acid 1 volume) was given before transferring the material to fluids 1, 2, or 3. The material was collected between 11 a.m. and 2 p.m. and fixed for 4–6 hours.

Material from twelve garden species of *Allium* was prepared by Taylor's (1924) smear method at the Chelsea Gardens and fixed in Taylor's (1924) fluid and La Cour's (1931) fluid 2B. In addition to smear preparations of anthers, flower buds of *A. stellatum*, *A. sp.* (unidentified), *A. alpinum*, and *A. montanum* were also fixed at Chelsea in both Taylor's and La Cour's fluids after previous dipping of the buds in Carnoy's mixture for a few seconds.

The formulæ of Navashin's and Carnoy's fluids were those given by Maeda (1930). On the suggestion of Mr. Semmens of this Department, Carnoy's fluid was modified by using 33 : 10 : 10 mixture. The results obtained by this modified Carnoy's mixture were satisfactory ; but fixatives in which osmic acid was used yielded more satisfactory preparations in *Allium* than either Carnoy's or Navashin's fluid. The paraffin material was cut 6–12μ thick. Both smear preparations and sections were stained with Newton's iodine gentian violet. Heidenhain's iron alum hæmatoxylin stain was tried ; but gentian violet was superior to hæmatoxylin in giving a clearer internal structure of chromosomes in all stages. In the description of plates, particulars regarding the source, fixing fluid employed, and other details of the material relating to each figure, are given.

III. Description of Meiosis.

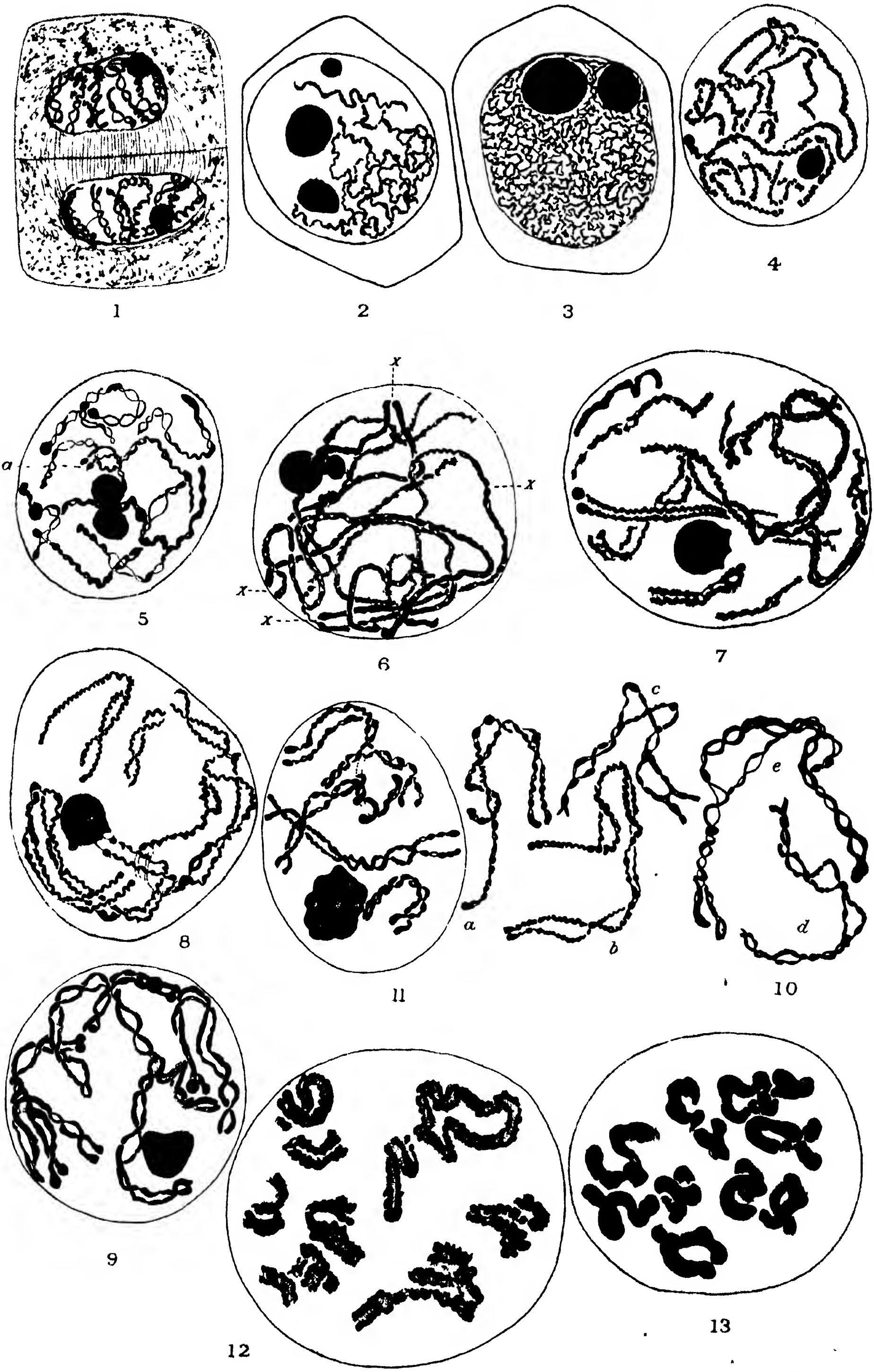
(*a*) *First Maturation Division. Resting and Prophase Stages.*—The pollen mother-cells of *Allium* at the resting stage have a polygonal outline with a more or less rounded nucleus and rich cytoplasmic contents (fig. 2). Two or more nucleoli are usually seen scattered in the tangle of chromatic threads. These are deeply stained and often present a vacuolate appearance. The cells soon become rounded and free. With the rapid increase in size of the nucleus, the chromatic threads also become more conspicuous (fig. 3). The

threads are spun into a " ball " enclosing one or two nucleoli. Careful examination of the nucleus at this stage has shown that these threads do not anastomose nor form a network, as often reported. They are corrugated and show a granular appearance at favourable portions of the strands. Imperfect fixation of these delicate threads may to some extent result in the retention of interchromosomal strands of karyolymph, giving the nuclear contents a reticulate appearance. In *Nicandra physaloides*, Janaki Ammal (1931) has observed at the close of the resting stage only a system of delicate threads, which give the appearance of a reticulum. No anastomoses were seen by Nebel (1933) in the resting nuclei of the Tradescantiæ.

The corrugated threads seen at the close of the resting stage soon become shorter and thicker (fig. 4), by axial contraction of the threads. The smaller nucleoli have all fused together into a composite nucleolus which shows a strong affinity for basic dyes. The threads now present a " beaded " appearance. The " beads " are of varying sizes and shapes ; but these were rarely seen to show a regular outline. In favourable portions of the threads, careful examination revealed a pair of minute projections on either side of these granules. Delicate strands were seen connecting the projections of adjoining " granules " (fig. 4). With advancing orientation of the nuclear contents for division, the granularity becomes less emphasized and the twisted aspect of these threads become more distinct (fig. 5). The interlacing of the two chromonemata with occasional forked ends (*a* in fig. 5) was so clear that there can be no doubt that in *Allium* the early leptotene threads are made up of two intertwined threads.

The structure of the leptotene threads has usually been interpreted as single, composed of uniseriate chromomeres, by a large number of investigators. The observations of a few workers in recent years have made this view highly questionable (Kaufmann, 1931a ; Smith, 1932). An examination of the telophase nuclei of the last archesporial division of *Allium* was specially made to find out if the chromosomes at that stage would throw any further light on this aspect of the problem. Here, too, the same interlaced threads with conspicuous diamond areas and occasional dual ends (fig. 1) were seen in each chromosome. This fact, together with the unmistakable indications of duality in the leptotene threads of *Allium*, has convinced the author that these emerge from the resting stage as double threads tightly twisted together, and that the beaded appearance seen at this stage is only an optical illusion due to their twisted nature.

With the organization of the spireme, a synizetic contraction is often reported in both plants and animals ; but in *Allium*, while there is a gradual and uniform contraction of the threads, and a slight shifting of position of the chromatic " ball " towards one side of the nucleus, as observed in Tulipa by Newton (1927), no synizesis is present. This agrees with the observations of Cleland (1924), who has regarded synizesis as an artifact due to the influence of fixing fluids. Taylor (1922) has found that in *Gasteria* synizetic contraction is completely eliminated by proper fixation.



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There is a marked increase in the size of the nucleus as prophase advances. Simultaneous with this growth, the erstwhile compact ball of chromatic threads spins itself out and the threads assume more peripheral positions in the nuclear chamber. They then lose their folds and bends, and occasionally some threads may be seen stretching across the chamber (fig. 6). By axial contraction the coils of the chromonemata are brought closer, forming thicker and shorter chromosomes. A number of free ends may easily be detected at this stage in uncut nuclei, so that it is quite certain that there is no continuous spireme.

The behaviour of the nucleolus at about this time appears to be peculiar. By budding it gives rise to a subsidiary nucleolus, which soon assumes the same globular form as its parent nucleolus. In several preparations the end of a chromosome was invariably seen to be in contact with a nucleolus, usually at the junction point of the two nucleoli (fig. 6). In the pollen mother-cells of *Oryza sativa*, Selim (1930) observed such pairs of nucleoli attached to the spireme. A definite connection between the spireme and nucleolus has been found in the pollen mother-cells of *Lathyrus* (Latter, 1926), *Lathræa* (Gates and Latter, 1927), and *Malva* (Latter, 1932). This relationship between the nucleolus and the spireme is assumed by these as well as a few other authors to signify a passage of material from the nucleolus to the spireme. Although no definite organic connection between these has been observed in the pollen mother-cells of *Allium*, the fact that in several preparations the end of a thread was invariably seen in contact with the nucleolus appears to denote a closer relationship than chance association. The leptotene threads at these early stages do not show any parallel arrangement of the chromosome halves, as reported by Nothnagel (1916) in *Allium tricoccum* and Digby (1919) in Osmunda. The two chromonemata of each chromosome are twisted around each other till their separation into independent coils at the subsequent stage. Taylor (1931) reports a single spiral structure in the early leptotene threads of *Gasteria ;* but an examination of his figure (fig. 2, pl. 27) for that stage would show that what he has described as spirals are only the zigzag folds of the threads.

Zygonema Stage.—When the threads have reached a certain degree of contraction a tendency for them to associate in pairs becomes evident. The pairing commences at the ends of chromosomes (x in fig. 6), as observed by Huskins and Hearne (1933) in oats, by Belling (1931) in Liliaceous plants, and by Gelei (1921) in Dendrocœlum. Farmer and Moore (1905) have described the origin of ring-chromosomes by the approximation and fusion of the extremities of pairing chromosomes. Hedayetullah (1933) has observed such union in *Œnothera missouriensis*, which has seven free pairs of chromosomes. In the formation of each ring pair one pair of free ends first comes together, later forming a ring by the similar union of the other ends of the homologous pair, the middle portions of the chromosomes remaining unpaired. For this condition he adopts the term "acrosyndesis." In *Allium*, pairing commences simultaneously at both ends of the pair. This proceeds

towards the constriction until close association is established between the pairs (figs. 6 and 7)—pachynema stage. The biological significance of this phenomenon cannot be over-estimated ; but the cytological factors involved in the process are still obscure.

The chromosomes now present a crenulate margin, and in regions where internal structure could be made out, uniform cross striations or compressed zigzag structures were seen. At some portions of the threads a single series of " granules " were also observed. At a slightly later stage—the diplonema —these were definitely biseriate. The biseriate appearance of these striations or " granules " is believed by many to be the clearest indication of cleavage at the diplonema stage. But a straight cleavage in each chromosome at this stage is highly improbable, as it would cut across its coiled chromonema. Nebel (1932), in his careful study of the internal structure of the chromosomes of Tradescantiæ, has reported the presence of two independent coils with their gyres fitting each other in each chromosome. Two interlaced threads can get separated into independent coils if, during their contraction, a reversed turn is effected in each twist of the double spiral. This can easily be demonstrated with a piece of cord. If two portions of it are first twisted around each other, and then each turn of the double coil is given a reversed twist, two separate coils will be formed with alternating gyres which can easily be pulled apart. It is highly probable that the interlaced chromonemata of each chromosome get resolved into two independent coils at the zygonema stage by this mode of contraction. These coils would appear as biseriate transverse bars or " granules," according to the diameter of each coil. The dual nature of each chromosome is thus brought out clearly ; but it does not mean that cleavage has been initiated at this stage, for the two chromonemata of each chromosome are formed as the result of a split at the late prophase of the last premeiotic division. Kaufmann (1931b) has interpreted the cross striations in the spireme of the salivary glands of Drosophila as indicating the coiled nature of its chromonemata.

Diplonema Stage.—The parallel association of pairing chromosomes at the zygonema stage is soon disturbed by the appearance of loops along the pair. The mode of loop formation has been interpreted in various ways. In *Allium* they are mainly formed by the twisting of the two chromosomes on each other as a result of the differential contraction of the chromosomes of each pair. This twisted appearance in the paired chromosomes is assumed by several investigators to be due to exchange of partners at points of contact of homologous halves of chromosomes, thus constituting a chiasma. It has also been pointed out " that a diplonema tetrad which has several chiasmata, and therefore several successive closed and open loops in alternating vertical and horizontal planes, may present a false appearance of twisting when viewed under the microscope "—Sharp (1934, p. 259). But it is very doubtful if the nodes at which the threads cross each other can all be taken as points at which exchange of partners occurs, for no organic fusion or any " break and join " is possible at these points, as the chromosomes are

subjected to contraction throughout this stage. There is considerable reduction in the number of these nodes as contraction proceeds. This reduction can only be regarded as due to the mechanical unwinding of the halves of the pair (Smith, 1932). Thus a decrease from a maximum of eighteen twists in the longest chromosome of *Allium* to about four or even less may be observed from diplotene to metaphase (*cf.* figs. 9 and 11). Levan (1931) has observed a reduction of these from ten or fifteen to two or three in the different diploid species of *Allium* which he studied. A few twisted bivalents drawn from different species of *Allium* are shown in fig. 10.

Diakinesis.—As contraction of the threads is reaching maximum, the bivalents assume more peripheral positions in the nuclear chamber. The coils of each chromonema are drawn closer, the matrix becomes conspicuous (fig. 12), and the arms of the bivalents bend in several ways, giving them all kinds of peculiar shapes. Several investigators have tried to find a solution of the debated problem of the mechanism of crossing-over from the configuration of the diakinetic chromosomes. Although their shapes are to some extent due to the position of the attachment constrictions, and to a varying degree to the points of actual contact (if any) between homologous chromosomes, this stage does not appear suitable for directing inquiry on this problem, as much of the internal structure of these chromosomes is obscured by intense contraction. The configuration of the bivalents is also very much complicated by the twisting and bending of their arms, and by changes in the degree of association between the two coils of the same chromosome as well as between sister coils of the bivalent. Hardly any value can therefore be given to a scheme which relates these curious shapes of the bivalents to the phenomenon of crossing-over. The figures of chromosome configurations at diakinesis in several of the recent cytological papers (Darlington, 1933), which undoubtedly are drawn from deeply stained preparations, would have had a different story to tell had the preparations been less stained. A comparison of fig. 13, drawn from a deeply stained preparation, with fig. 12, from a less stained one, at more or less similar stages, would show the extent to which internal structures are obscured in deeply stained preparations.

The nucleolus becomes vacuolate (fig. 11), it gradually diminishes in size, and finally disappears along with the nuclear membrane. The bivalents then arrange themselves at the heterotypic spindle.

Metaphase.—The bivalents which are arranged at the heterotypic spindle still show a few twists on each arm (figs. 14 and 15). In this, as well as the quadruple structure of the bivalents, they bear a close resemblance to the metaphase chromosomes of mitotic division ; but the number of the bivalents is only half that of the latter, i.e., eight. In fig. 18 the members of the same pair are indicated by corresponding numbers 1–8. In the subsequent scheme of events there is hardly any feature to differentiate their behaviour from that of mitotic chromosomes. Separation is preceded by an untwisting, and

the univalents move apart with reference to the constriction, as already described in normal mitosis (Koshy, 1933b).

Anaphase.—Separation of the homologues arranged at the spindle is a slow process. The separating chromosomes present various shapes, a few of which are shown in fig. 16. Usually the halves of a single pair (shortest of the group in *Allium*) migrate earlier than the rest (fig. 17), as also observed in *Gasteria* by Taylor (1931). As the chromosomes move to the poles, the two independent parallel coils of each may slip out, especially at the distal ends. Their arms diverge more and more, though retaining union at the constriction. Characteristic X-shapes are thus formed in these chromosomes (fig. 19). Taylor (1931) has observed in *Gasteria* a continuous chromonematal rod in each half-dyad chromosome with five to six right- or left-handed twists. He has also seen the twist reversing its direction in part of a chromosome.

Telophase.—On reaching the poles, a process of expansion of the coils is soon commenced in each chromosome as in mitotic telophase. A nuclear membrane is formed round each daughter group and one or more nucleoli appear (fig. 20). But the heterotypic telophase presents a different picture from that in mitotic divisions. The chromonemata of each somatic chromosome being twisted together, clear diamond areas are seen during the expansion of its double coil. In the heterotypic telophase, owing to the separation of the chromonemata into independent coils, no such areas are present (fig. 20). Nebel (1932) has presumed that reduplication of each chromonema occurs at the telophase in both meiotic and mitotic divisions, and has reported four independent spirals in each telophase chromosome of Tradescantiæ. This conclusion cannot be accurate, as it may easily be shown that unravelling is necessary for the separation of the two coils formed by the reduplication of the chromonematic coil, because only an interlaced double coil (and not one coil fitting into another) will be formed if the reduplication of the coiled chromonema "occurs in a plane parallel to *one* (and only one) plane passing through the main axis of the chromonema," as suggested by him.

(*b*) *Second Maturation Division.*—The quadripartite figures characteristic of the previous anaphase and telophase are retained in the chromosomes up to the early stages of the second maturation division. In the majority of cases examined, no definite period of rest is seen to intervene between the two divisions of meiosis. In the few cases where definite resting nuclei were available, no anastomosing strands developing a network were observed. Maeda (1930) has found the same condition in Lathyrus. The extended arms of each chromosome reassume spirality by contraction, becoming shorter and thicker (fig. 21). At the late prophase, traces of duality in each coil are discernible, indicating that cleavage has been initiated at this stage (fig. 22). Taylor (1931) has reported the origin of duality at this stage in Gasteria.

Metaphase.—At the homotypic spindle the quadripartite chromosomes arrange themselves in such a way that their arms are symmetrical with

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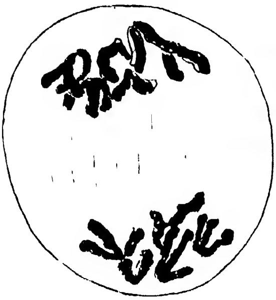

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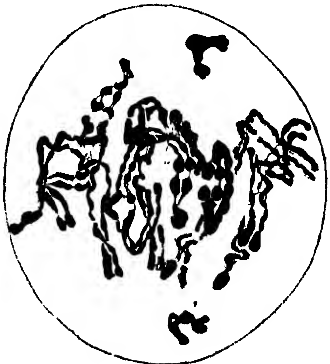

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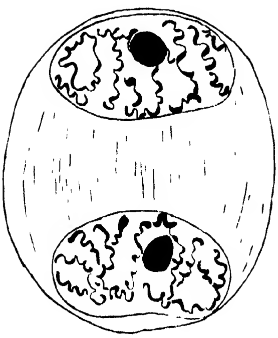

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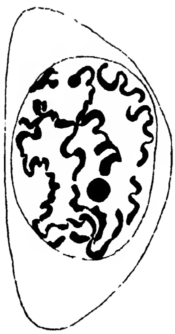

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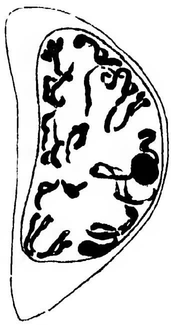

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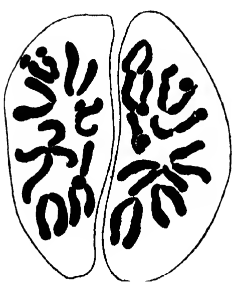

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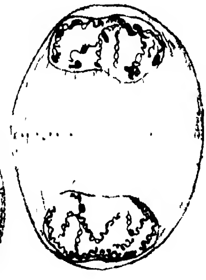

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Huth lith.

reference to the plate (side view, fig. 23; polar view, fig. 24). These chromosomes are shorter and thinner than the chromosomes at the corresponding stage of the first division. This may be due to the rapidity with which these divisions are gone through, leaving the chromosomes scarcely any time for growth. Owing to intense contraction, neither the coiled chromonemata nor the dual nature of each chromatid was very clear. The separation of the daughter chromosomes is easily accomplished, as their arms are free except at the attachment constriction.

Anaphase and Telophase.—The anaphasic separation commences at the constriction. As the chromatids move apart, the apex of the V's turns from the equator of the spindle to the poles (*cf.* figs. 23 and 25). The twisted structure of chromosomes was more evident here than in the preceding stage (figs. 25 and 26). On reaching the poles, the arms of the chromosomes fold up, and by a gradual expansion of the coils, followed by the development of an enveloping membrane, the daughter nuclei are organized (fig. 27).

The homotypic telophase chromosomes do not differ from those in the somatic division in any detail. The same interlacing chromonemata and distinct diamond areas were seen here as in the mitotic telophase stage. Taylor (1931) has described in *Gasteria* a process of straightening of the double coil at about this stage, which, according to him, results in separating the interlacing chromonemata as parallel bands. His fig. 9 of pl. 29, which is designed to show such parallel bands, while conspicuous by the absence of any parallel bands, clearly shows intertwined chromonemata. At no stage in the history of *Allium* chromosomes has it been possible to observe the two chromonemata of a chromosome as parallel bands.

On the completion of these developmental processes, cytokinesis is accomplished by furrowing. Thus *Allium* combines the formation of a cell wall on the heterotypic spindle, as in Monocotyledons, with furrowing of the dyads, which resembles the condition found in Dicotyledons.

IV. Discussion.

There is now general agreement that the chromonemata constitute the chromatic part of chromosomes; but, probably due to a misconception of the exact nature of these delicate threads, there is considerable confusion in the interpretation of their behaviour, especially in meiosis. In the history of both somatic and meiotic chromosomes we see amazing variations in form and apparent internal structure; yet there is hardly any aspect of their history which could not directly be traced to either the dual nature of these threads in the constitution of each chromosome or their twisted aspect. Well-marked gradations exist between the compact cylindrical coils of the metaphase and the zigzag double threads twisted together at the resting and early prophase stages. Further evidence of this view has recently been obtained by Kuwada and Nakamura (1934), who succeeded in effecting a regression of metaphase and anaphase nuclei of pollen mother-cells of

Tradescantia reflexa to the resting condition by treating them with ammonia vapour, producing thereby artificial unravelling of the coiled chromonemata. The dual nature of these at the resting stage is not made out under the microscope, as the threads are normally below the limits of resolution. During the prophase contraction a secondary spiral is developed in each chromonema, giving the chromosome a " spiral-twisted-on-spiral " structure. We have thus a consistent picture of chromosomes in relation to their chromonematic structure in all stages of their history ; but the time at which cleavage occurs in each chromonema is still a debated problem.

Leaving aside the question of duality or singleness of chromonema at any particular stage, if it will be conceded that the split in each coiled thread is along its axis, an interlaced spiral, and not two independent spirals as assumed by Nebel (1932), will be formed. This aspect of reduplication of chromonemata has not received adequate consideration. Competent investigators like Kuwada and Taylor, who are fully convinced of the persistence of coiled chromonemata in chromosome constitution, have interpreted the phenomena of cleavage and spirality of chromonemata by assuming that longitudinal cleavage occurs in each chromonema at a time when it is straight, forming two independent spirals by subsequent spiralization. But at no stage of the chromosome cycle are these threads observed to be straight, and, moreover, such reduplication of the chromonema would not satisfactorily explain the fact that the chromosome halves are twisted together at the telophase and prophase stages so characteristic of large chromosomes such as those of *Allium.*

The meiotic chromosomes do not differ from those of the somatic in any important detail of structure. The same double, coiled chromonematic structure is seen in all stages of meiosis. There are, however, certain aspects of their history which may appear to deviate from the general scheme ; but these are easily explained on the basis of their duality and spiral character.

(1) *Duality or Singleness of Leptonema.*—Till recently the early leptotene threads were considered to be unitary structures, and duality in each chromosome was believed to occur after the pairing of homologous chromosomes. As shown in an earlier paper (Koshy, 1933b), this view is contrary to facts. The recent investigations of Sharp (1929), Kaufmann (1926a), and several others have definitely proved that in the mitotic cycle large somatic chromosomes split at the prophase of the division previous to the one at which these halves separate. This would mean that the early prophase chromosomes of meiosis are double, unless it be that cleavage has been suppressed in the last premeiotic division, as suggested by Huskins (1932).

Darlington (1929) accounts for the apparent duality of the anaphase and telophase chromosomes in mitotic divisions on the ground that " if a hollow, translucent cylinder is examined in the plane of its axis it appears as though in section, that is, like two parallel rods." A hollow cylinder in optical section may give the appearance of two parallel rods ; but the anaphase and

telophase chromosomes are seen as composed of two *twisted* and not parallel threads, and the characteristic diamond areas of the telophase chromosomes cannot in any manner be traced to a hollow cylinder.

Smith (1932) has shown that each leptotene strand of Galtonia represents closely associated halves of a single chromosome. Newton's (1927) figures of leptotene threads of Tulipa show clear indications of the twisted nature of these threads. Kaufmann (1931a) has shown the existence of duality in the leptotene threads of *Tradescantia pilosa* and *Rhœo discolor.* Bridges (1916) and Muller (1928) contend that the genes are split before synapsis in *Drosophila.* Guyénot and Naville (1929) claim to have observed a precocious splitting of the chromosomes in both male and female *Drosophila,* and a later association of these split chromosomes in pairs. In the several species of *Allium* studied by the author there were clear evidences of closely twisted dual threads at the early prophase stage of meiosis. Observations such as these can only lead one to the conclusion that the leptotene threads, like the early prophase chromosomes of mitosis, are composed of *two* chromonemata twisted on each other, presenting a granular appearance when seen under the microscope.

Mather and Stone (1933) observed in the somatic chromosomes of *Crocus* certain abnormalities as a result of X-radiation. The two halves of these abnormal chromosomes were found to be equal at the late prophase and metaphase stages. On this ground the authors argue that cleavage in each chromosome occurred after the production of the abnormalities. Irradiation is found to be effective only in the chromosomes of the resting stage, and so they conclude that the chromosomes emerge from the resting stage as single and get split subsequently. Their argument does not appear sound ; for if, as we believe, the two chromonemata are so closely associated in the resting nucleus as to be unresolvable under the microscope, then it is not unlikely that both threads would receive the same effect and produce the same abnormality by the impact of a particular X-ray particle. Even if unequal abnormalities are absent, this does not thus negative the view that the chromosomes are double at the previous anaphase and telophase stages.

(2) *Factors affecting Chromosome Pairing.*—The two members of each pair of homologous chromosomes present in the diploid complement establish intimate association between them at the prophase of the first division of meiosis. There is no doubt that this phenomenon—synapsis—has important genetical significance ; yet we are still in the dark regarding the factors involved in the process. According to Darlington (1931), the chromosomes at a certain degree of contraction have an attraction for each other in pairs. He argues that in mitosis this attraction is satisfied by the approximation of the split halves of each chromosome at the early prophase stage. In meiosis, a precocious contraction occurs in each chromosome before cleavage, and consequently this attraction manifests itself between homologous single chromosomes. Thus premature contraction and delayed splitting are assumed by him to upset the normal scheme of events prevalent in mitosis

and to bring about meiosis. This view is based on the assumption that the leptotene threads are single; but, as shown above, this is contrary to observed facts. Huskins (1932) has suggested a modification of this hypothesis, in that meiosis is initiated by a retardation or inhibition of a split in the chromonema in the last premeiotic division.

Further evidence to this has recently been advanced by Huskins and Smith (1934), who report the earliest leptotene chromosomes of *Fritillaria Meleagris* as "in part single and in part double," and pairing is seen to occur only along the unsplit segments of the homologues. Their figures of these chromosomes (figs. 1–3) show well-spaced-out spherical chromomeres in alternating single and double rows in each, the latter being formed by interrupted straight cleavage in segments of the thread. According to this observation, cleavage in each chromosome is initiated in the premeiotic stage and completed after pairing. This should naturally mean that the chromonema of each chromosome remains as a straight thread from the prophase of the preceding division, where the split is commenced, to the diplotene. Kaufmann (1926b) has shown in the meiotic prophase of *Podophyllum,* intertwined homologues each being longitudinally divided, "the split separating parallel spiral threads." The recent experiments of Kuwada and Nakamura (1934) as well as my own observations have shown that the chromonemata exist in a coiled state in almost all stages of the chromosome cycle. The cleavage of the chromosome can therefore be neither straight along its axis nor a slow process initiated in the premeiotic stage and completed after pairing. It is not unlikely, therefore, that the apparent unsplit regions of leptotene threads observed by Huskins and Smith are really segments where the two chromonematic coils lie one above the other or in close contact with each other and the so-called chromomeres are images of these coils.

In certain Orthopteran chromosomes duality has clearly been demonstrated in the telophase of the last premeiotic division by McClung (1928) and Robertson (1931). Careful examination of the telophase nuclei of the last archesporial division in *Allium* has afforded convincing evidence (see fig. 1) that these do not differ in any manner from those in the somatic divisions, and the indubitable evidence of duality of the leptotene threads reported by several investigators makes it conclusive that there is no suppression of cleavage in the last premeiotic division. We have therefore to face the problem of pairing of double and not single homologues.

Gates (1932), in a survey of Nuclear Structure in his Presidential Address to the Royal Microscopical Society, states that "We are quite without any basis for an explanation of this phenomenon [of specific attractions] at the present time, and even a knowledge of how the genes divide would not appear to help us." Cytological evidence from various sources confirms the view that homologous genes have specific attraction between them. This attraction may or may not manifest itself in somatic chromosomes, but in the majority of plants and animals studied, this attraction is so strong in the

leptonema that it has even been regarded as sexual in character. In the present state of our knowledge, therefore, the phenomenon of pairing can only be interpreted as due to the development of specific attractions between homologous genes in the chromosomes. The association of pairs of chromosomes, each of which is composed of two chromonemata, at the prophase of meiosis thus results in the development of quadruple bivalents. This is significant, inasmuch as a condition is thereby established in each bivalent to make it correspond to the quadruple chromosomes of the late prophase of mitotic divisions. There is, therefore, no need for a further division in each thread, and consequently complete suppression of cleavage at the first division of meiosis is only natural.

(3) *The Mode of Separation of the Interlaced Chromonemata.*—In the early prophase stages of meiosis the two chromonemata of each chromosome have been shown to be twisted on each other. During synapsis and subsequent stages these are seen as two free parallel coils. This is in agreement with the observations of Nebel (1932) in Tradescantiæ. Two interlaced threads can become independent coils if the threads straighten out, unwind, and then spiralize individually, or if a reversed turn occurs in each coil of the double spiral. It is impossible to assume that the former process can be operative, as the prophase threads are in active contraction throughout this stage. The separation of the interlaced leptonema into independent coils is therefore assumed to be brought about by a reversed turn in each coil of the thread during its contraction. The gyres of the two coils thus formed will correspond with each other, and would appear as a double row of granules. This appearance has been mistaken by several workers as indicating cleavage in each "chromomere" at the diplotene stage. These in fact are only the images of the biseriate, close coils of the two free chromonemata.

(4) *Exchange between Chromonemata of Homologous Chromosomes.*—Although Morgan's well-known hypothesis about exchange of genes (crossing-over) between homologous chromosomes is amply substantiated by genetical evidence, cytological interpretations of the mechanism of crossing-over have not yet passed the stage of speculation. Most investigators agree that this exchange of particles or segments of chromonemata takes place at the early prophase of the heterotypic division, when the pairs are in close association. At this stage, however, most materials do not appear to yield sufficiently satisfactory details of their structure to explain their behaviour. The problem is further complicated by the fact that the degree of pairing varies with individuals, and definite cases of genetic asynapsis have recently been recorded by several investigators (Huskins and Hearne, 1933). In the present study of the meiotic chromosomes of *Allium* no convincing evidence of crossing-over was obtained.

Darlington (1931) describes the early leptotene threads as "single, undivided, coiled." There is evidence that this coiled nature of the threads persists in subsequent stages as well. It is therefore obvious that when such coiled chromonemata pair, particle-by-particle association and exchange are

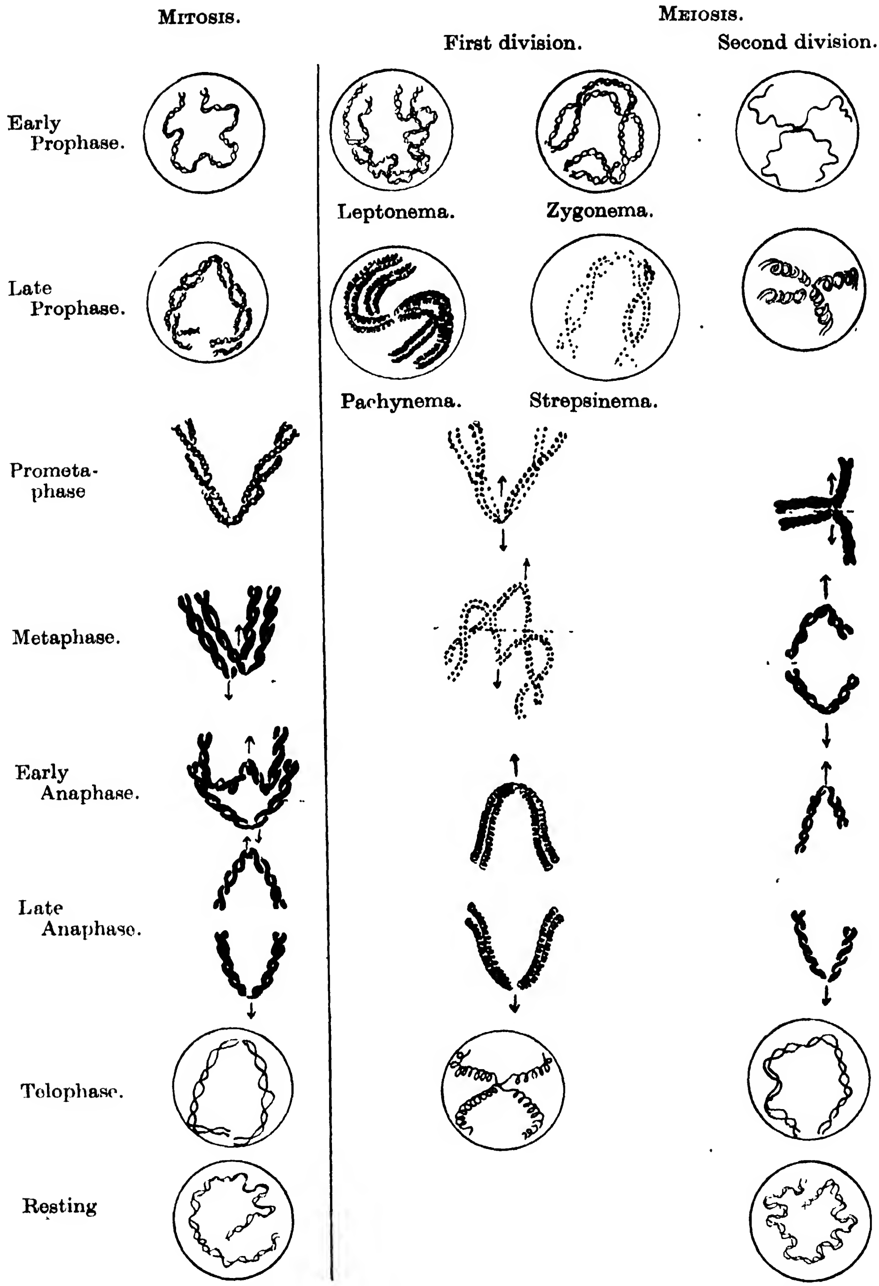

Diagram showing the history of one chromosome in mitosis, and, for comparison, that of two pairing chromosomes in meiosis. The two divisions are essentially the same in regard to their structure and behaviour. While a quadruple structure is formed in each chromosome at the late prophase of mitosis by cleavage in each chromonema, the pairing of homologous dual chromosomes and consequent suppression of cleavage at the first division establish similar conditions in meiosis prior to the separation of the paired halves of each quadruple structure.

impossible. Again, if cleavage takes place *after* the pairing of such coiled threads, what is the line of cleavage and how do the halves separate? The different interpretations of the mechanism of crossing-over are based on the assumption that the cleavage is straight in the paired threads. This view is untenable if the chromonemata exist in a coiled state. This and other problems connected with the mechanism of crossing-over will be treated more fully in a subsequent paper.

In tracing the history of the meiotic chromosomes in the several species of *Allium*, the dual nature of each chromosome has been observed in all stages, as in somatic chromosomes. At the commencement of meiotic activity the apparently granular leptotene threads are double, being composed of two twisted chromonemata. During the contraction of chromosomes a reversed turn is effected in each coil of the double spiral, with the result that two independent spirals with the gyres of one alternating and fitting into those of the other are formed in each chromosome. The chromosomes then associate in pairs. The quadruple bivalents arrange themselves at the heterotypic spindle, and their halves separate as in ordinary mitosis. In the subsequent scheme of events there is hardly any feature of structure to differentiate them from somatic chromosomes. Synapsis at the heterotypic prophase, and consequent suppression of cleavage, thus bring meiotic divisions into line with ordinary mitosis, satisfying at the same time the genetic requirement of chromosome reduction to the *n* number.

These phases in the history of chromosomes in both mitosis and meiosis are shown schematically in the above text-figure.

V. *Summary.*

(1) Two-coiled chromonemata are present in each chromosome in all stages of the meiotic cycle of *Allium*. This condition has been observed in the telophase of the last premeiotic mitosis (fig. 1).

(2) The chromonemata exist as intertwined threads in the early prophase (leptonema) stage of meiosis.

(3) The intertwined chromonemata become independent parallel coils by a reversed turn in each twist during prophase contraction.

(4) The pairing, which commences simultaneously at both ends of the homologues, proceeds towards their constrictions until close (side-by-side) association is established between them.

(5) At diplotene, the synaptic mates get twisted on each other (strepsinema) as a result of differential contraction of the members of the pair.

(6) The organization of a quadruple structure being indispensable for the maintenance of duality in each chromosome, cleavage is initiated in each chromonema before the separation of daughter chromosomes in mitosis. In meiosis, such quadruple structures are formed by the close association of homologous dual chromosomes. There is thus a complete suppression of cleavage in the first meiotic division.

(7) The univalent chromosomes which move apart to the poles of the heterotypic spindle have two coiled chromonemata in each.

(8) At the late prophase of the second division cleavage occurs in each chromonema.

(9) Two interlaced chromonemata are present in the telophase chromosomes of the tetrad nuclei.

(10) The meiotic chromosomes are thus similar to somatic chromosomes in regard to their structure and behaviour. Synapsis at the heterotypic prophase, and consequent suppression of cleavage at the first division, effect the genetic requirement of chromosome reduction to the *n* number.

In conclusion, the writer wishes to express his thanks to Prof. Ruggles Gates, F.R.S., for valuable suggestions and criticisms during the progress of this investigation. He is also indebted to the Government of H.H. The Maharajah of Travancore for the facilities offered in connection with this work at the University of London.

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EXPLANATION OF PLATES.*

All figures are drawn at table level, with the aid of a Reichert camera lucida, using a Busch $\frac{1}{12}$-inch oil immersion, N.A. 1·30, aplanatic condenser N.A. 1·40. Special care was taken to obtain critical illumination. The magnification of each figure is noted in the description.

PLATE IV.

Fig. 1.—Telophase of last archesporial division in *Allium porrum* fixed in Flemming's medium fluid. The intertwined character of the dual threads of each chromosome is seen exactly as in mitotic telophase. The bifid ends of some chromosomes (second on the left of lower nucleus) indicate the duality very clearly. × 2,600.

Fig. 2.—Pollen mother-cell of *A. porrum* at resting stage fixed in Flemming's medium fluid. × 3,400.

Fig. 3.—Pollen mother-cell in a section of *A. cepa* (var. Sutton's Globe onion) fixed in Flemming's medium fluid, showing the commencement of meiotic activity. The tangled leptotene threads present a granular appearance. × 3,400.

Fig. 4.—Nucleus from a section of *A. siculum* fixed in Improved Carnoy's fluid. The " chromomeric " appearance is more prominent, and the interlacing nature of the tangled threads may be made out at some regions (12 o'clock) in the figure. × 1,700.

* The publication of these plates has been aided by a grant from the University of London Publication Fund.

Fig. 5.—Leptotene threads in a section of the anthers of *A. sp.* fixed in Flemming's medium fluid, showing the interlacing nature of the two chromonemata. The chromomeric appearance is not so prominent here as in fig. 4. The forked ends of a chromosome are shown at *a*. × 2,600.

Fig. 6.—The beginning of synapsis in section of *A. sp.* fixed in Flemming's medium fluid. The approximation of the ends of pairing chromosomes at the commencement of this process is seen at *x*. × 2,600.

Fig. 7.—A cell from a section of *A. sp.* fixed in La Cour's 2B, at the zygonema-pachynema stage. × 2,600.

Fig. 8.—Nucleus from a section of *A. sp.* fixed in La Cour's 2B. The pairing threads during contraction give a crenulate margin, and the biseriate nature of the "granules" may be made out at some regions. The bivalents get twisted together. The delicate strands connecting a bivalent to the nucleolus are clearly seen. × 2,600.

Fig. 9.—A nucleus at diplotene stage from a smear preparation of *A. angulosum* fixed in La Cour's 2B, showing characteristic twisting of the bivalents. × 2,600.

Fig. 10.—The twisted bivalents selected from different cells. *a* and *b* from *A. sp.* fixed in La Cour's fluid 2B ; *c* and *d* from same material fixed in Flemming's medium fluid. *a–d* × 2,600. *e* × 3,400.

Fig. 11.—The late diplonema (strepsinema) stage in a smear preparation of *A. angulosum* fixed in La Cour's 2B. The twists are very much reduced and the nucleolus shows a vacuolate appearance. × 2,600.

Fig. 12.—The twists and bends formed in each bivalent during the diplotene contraction are seen in a less stained preparation of *A. album* fixed in Taylor's fluid. The crenulate margin and apparently biseriate "chromomeric" appearance of each chromosome are indicative of the separation of the chromonemata into independent coils during contraction. × 2,600.

Fig. 13.—Nucleus from a deeply stained section of *A. sp.* at a stage similar to fig. 12. The internal structure of chromosomes is considerably obscured by the stain. × 2,600.

PLATE V.

Fig. 14.—Nucleus at heterotypic metaphase in a deeply stained section of *A. sp.* fixed in Flemming's medium fluid. × 2,600.

Fig. 15.—Side view of chromosomes arranged at the heterotypic spindle in a deeply stained preparation of *A. alpinum* fixed in La Cour's 2B. Anaphasic separation has commenced in a few chromosomes. × 2,600.

Fig. 16.—Configuration of a few anaphase chromosomes from the above preparation. × 2,600.

Fig. 17.—A cell from a smear preparation of *A. angulosum* fixed in La Cour's 2B. The univalents have completely separated. The shortest pair of the complement has already migrated to the poles. × 2,600.

Fig. 18.—Early anaphase chromosomes in a smear preparation of *A. angulosum* fixed in La Cour's 2B. The chromosomes of each bivalent are marked by corresponding numbers, 1–8. × 2,600.

Fig. 19.—Heterotypic anaphase in a section of *A. alpinum* fixed in Flemming's medium fluid The diverging arms of a few chromosomes are seen in it. × 2,600.

Fig. 20.—Heterotypic telophase in smear preparation of *A. stellatum* fixed in La Cour's 2B. During the expansion of the coils no diamond areas are formed, as the interlacing chromonemata have separated into independent coils. × 2,600.

Fig. 21.—Homotypic prophase from a section of *A. sp.* in Flemming's fluid. The cruciform shape of chromosomes is made out in some chromosomes (11 o'clock in figure). × 2,600.

Fig. 22.—Late prophase from section of *A. sp.* in which duality may be seen in some threads. × 2,600.

Fig. 23.—Metaphase of second division from a section of *A. alpinum* fixed in medium Flemming. The chromatids are not twisted, and each pair assumes a symmetrical position on the plate. × 2,600.

Fig. 24.—Polar view of dyad at homotypic metaphase from a smear preparation of *A. alpinum* fixed in Taylor's fluid. The cruciform shape of chromosomes is seen at 9 o'clock in the figure. × 2,600.

Fig. 25.—Anaphase in second division from section of *A. alpinum* fixed in medium Flemming. The interlaced chromonemata of each daughter chromosome are seen clearly at this stage. × 2,600.

Fig. 26.—The chromosome complements of a tetrad at anaphase in a section of *A. alpinum* fixed in medium Flemming. × 2,600.

Fig. 27.—Telophase in second division in a section of *A. alpinum* fixed in Flemming's medium fluid. The diamond areas formed by the expanding double coils of each daughter chromosome are clearly brought out in it. × 2,600.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(*Under the direction of* G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE.

The Effects of Fixatives and H-ion Concentration on Acid Fastness.—J. W. FIELDING ("The Staining of Acid-fast Bacilli. The Effects of Fixatives and H-ion Concentration on Acid-fastness," *Austral J. Exp. Biol.*, 1934, **12**, 1–5). Fixation of tissue in formalin for as long as 20 years does not affect the acid fastness of tubercle bacilli, while storing for 3 years in methylated spirit did not destroy acid fastness when alkaline fuchsin was used as a stain. Neither acetone nor a combination of acetone and formalin is responsible for loss of acid fastness. Autolytic action in tissues is responsible for lowering the *p*H value of the fixative. Low *p*H values are responsible for the change in the staining reaction of acid-fast organisms. If the *p*H of the fixative is kept on the alkaline side or staining is carried out with an alkaline fuchsin there is no loss of acid fastness. G. M. F.

The *p*H of Formalin—its Importance in Fixation.—F. V. BURKE ("The *p*H of Formalin—a Factor in Fixation. Adjustment and Stabilization of the Hydrogen Ion Concentration of Formalin Solution," *Amer. J. Path.*, 1934, **9**, 915–20) All dilutions of commercial formaldehyde in distilled water are acid. To neutralize formalin it is recommended to add pyridine, 5 c.c. of pure pyridine being added to 75 c.c of distilled water and 25 c.c. of commercial formalin. Tissue should be immersed in approximately twenty times its weight of pyridine-formalin. Forty-eight hours is sufficient time for fixation though in preparing tissue for peripheral nerve stains 2 weeks is preferable. Tissue can be immersed for 6 months in pyridine-formalin without injury and may be treated with all the usual stains. G. M. F.

A Simple Method of Staining Negri Bodies.—G ZOTTNER ("Coloration simple, sûre et rapide des corpuscules de Negri dans les coupes," *Compt. rend. Soc. Biol.*, 1934, **115**, 593–4). Paraffin sections of the horn of Ammon are passed through xylol to absolute alcohol; without washing, a few drops of a solution of nitric acid (1 in 3) are placed on the section and left for 2 or 3 minutes. The acid is then drained off and a few drops of Ziehl's fuchsin are run on to the section for 15 seconds. Wash rapidly and allow the following freshly prepared mixture to stain for 15 seconds: equal parts of a saturated aqueous solution of picric acid and 1 p.c. indigo carmine; dehydrate and differentiate in absolute alcohol. As soon as the sections begin to take a greenish tint, clear in xylol and mount in Canada balsam. The Negri bodies are red or ruby rose in colour, neuroglia bright green, cell protoplasm green or purplish green, nucleoli and chromatin deep brown or garnet coloured, G. M. F.

Victoria Blue as a Stain for Filterable Viruses.—K. Herzberg ("Viktoriablau zur Färbung von filtrierbarem Virus (Pocken-Varizellen- Ektromelia- und Kanarienvogelvirus)," *Zentralb. f. Bakt. Orig.*, 1934, **131**, 358–66, 1 pl.). Victoria blue 4R may be used as a stain for the elementary bodies of various viruses, notably those of canary-pox, ectromelia, variola and less satisfactorily varicella and herpes simplex. For the canary-pox virus smears are first made, washed in distilled water for 10 minutes, and dried for 1 hour in air. Staining is carried out as follows: 1 hour in a 0·1 p.c. solution of Bayer's "Kernecht" red; 30 seconds in distilled water, then 30 seconds in a second glass of distilled water; dry for ½ hour in air, 1 p.c. light green solution for 2 minutes; wash in two changes of distilled water, 5 seconds in each; 10 p.c. solution of tartaric acid 2 minutes; drain off and again wash for 5 seconds in two lots of distilled water; 0·1 p.c. solution of Victoria blue 4R; drain off and wash in distilled water as before; dry in air. The staining solutions are prepared as follows: (1) "Kernecht" red solution—5 gm. of aluminium sulphate are dissolved in warm water and filtered, 0·1 gm. of neutral red is dissolved with boiling and the solution is again filtered; 0·5 c.c. of 10 p.c. acetic acid is added. (2) Light green—1 gm. is dissolved in 100 c.c. distilled water in the cold and 0·5 c.c. of 10 p.c. acetic acid is added. (3) Victoria blue 4R—0·1 p.c. solution. The standard solution was made up as a 3 p.c. solution. To every 10 c.c. of the diluted stain 0·5 c.c. of 10 p.c. acetic acid was added. G. M. F.

A Method of Staining Inclusion Bodies.—T. Hamilton ("Methyl-blue and Hot Alcoholic Eosin as a Stain for 'Inclusive Bodies' in Virus Diseases," *J. Trop. Med. and Hyg.*, 1934, **37**, 139–40). Small pieces of tissue are fixed in Helly's fluid, embedded in paraffin, sectioned at from 4μ to 6μ, and brought down to water with the usual precautions. The following technique is then followed: stain with equal parts of saturated alcoholic eosin and 0·5 p.c. aqueous eosin, applying slight warmth, set the stain alight and allow the flame to burn out; flood the slide again with stain and repeat the process; allow the slide to cool; drain off what stain remains, without washing pour over the slide a saturated solution of potassium alum, tip off the precipitate formed; place the slide, without washing, in a cylinder containing the same saturated potassium alum; leave for 10 minutes or longer. Wash carefully in running water; rinse rapidly in ammoniated spirits (1 drop of strong ammonia to 25 c.c. of methylated spirit) and keep the slide moving. Examine under the microscope, taking care not to allow drying. Carry the decolorization only to the point of a bright pink coloration in the tissues and a vermilion colour of the red blood cells. Stop the decolorization by washing in water, stain for 10 or more minutes in 0·5 p.c. aqueous methyl blue, examine microscopically without washing till the background is dirty blue-red and the red cells still vermilion; flood the slide with absolute alcohol; flood the slide with ammoniated absolute alcohol (1 drop to 25 c.c. alcohol); watch with great care the differentiation under the microscope till the background is very faintly blue and red blood-cells and nucleoli are strongly vermilion; wash in water, blot carefully with filter paper, dehydrate, clear in benzol, and mount in Canada balsam.

G. M. F.

Cytology.

Vital Staining in certain Flagellates, the Chemical Affinities of the Cytoplasm, and its Various Constituents.—P. Gavaudan ("Sur les colorations vitales diffuses de quelques flagellés et les affinités chimiques du cytoplasme et de ses divers constituants," *Compt. rend. Acad. Sci.*, 1934, **198**, 848–50). Many

flagellates, such as *Polytoma uvella*, *Chilomonas paramœcium*, *Euglena quartana*, and various Monas, Ochromas, and Boda are stained vitally. In *Polytoma mobile* individuals may be seen with nucleolus and cytoplasm stained deep blue by cresyl blue, while the vacuome, when coloured, is reddish-violet. The leucoplast is not coloured. Loss of coloration occurs rapidly in a few minutes in preparations made under a cover-glass but remains for some hours in a hanging drop.
G. M. F.

Vitamin C in the Ovary and Corpus luteum.—A. GIROUD, C. P. LEBLOND, and M. GIROUX ("La vitamine C dans l'ovaire et le corps jaune," *Compt. rend. Acad. Sci.*, 1934, **198**, 850–1). By reduction with silver nitrate vitamin C can be shown to be present in the testicle and ovary. In the testicle the vitamin is found especially in the cells of Sertoli and in the interstitial cells. In the ovary the interstitial cells and the cells of the corpus luteum are specially rich. G. M. F.

The Chromosome Sheath in Mitosis and in Relation to Mitosis.—C. W. METZ ("The Rôle of the 'Chromosome Sheath' in Mitosis and its possible Relation to Phenomena of Mutation," *Proc. Nat. Acad. Sci.*, 1934, **20**, 159–62). Evidence is brought forward to show that the chromosome sheath plays an important rôle throughout the whole process of mitosis, including meiotic division. It is believed that the enveloping sheath serves at first to hold the two sister chromosomes together and that it gradually undergoes longitudinal division as separation progresses. Variations in the degree of association and in the behaviour of the sister halves would therefore depend on variations in the time and rate of division of the sheath. It is suggested that irradiation and exposure to heat, which increase the tendency to mutation, act by disturbing the normal insulating properties of the chromosome sheaths, thus allowing intimate contacts between the chromosomes. G. M. F.

The Action of Morphine on the Structure of the Cell.—E. S. HORNING ("Cytopathological Studies of Morphine Poisoning and Chronic Morphinism in the Albino Rat, with reference to Subsequent Lecithin Treatment," *Amer. J. Path.*, 1934, **10**, 219–52, 6 pls) In acute morphine poisoning the cell inclusions show variable but non-specific changes More significant but still inconstant alterations follow addiction for six or more months: in the glands of the stomach and duodenum the Golgi apparatus is depleted while mitochondria are frequently fragmented and without regular polarity. Minor changes are recorded in pancreas, thyroid, and liver. Morphine poisoning does not produce alterations in the mineral constituents which can be detected by microincineration. G. M. F.

The Relation of Hydrogen Ion Concentration to the Character of the Cells of an Inflammatory Exudate.—V. MENKIN ("Studies on Inflammation. X. The Cytological Picture of an Inflammatory Exudate in Relation to its Hydrogen Ion Concentration," *Amer. J. Path.*, 1934, **10**, 193–210). When the *p*H of a pleural inflammatory exudate is alkaline the percentage of polymorphonuclears at the site of inflammation exceeds that of the mononuclear phagocytic cells. When the *p*H of the exudate is approximately neutral the percentage of polymorphonuclear cells tends to approach that of the mononuclear phagocytes. When the *p*H of the exudate is definitely acid large numbers of polymorphonuclear cells are found degenerated. The percentage of relatively normal appearing polymorphonuclear leucocytes is found considerably lower than that of the mononuclear phagocytes. By measuring the hydrogen ion concentration of an inflammatory exudate the character of the cytological picture can be predicted with a fair degree of certainty;

the reverse is also true. A pleural inflammatory exudate usually develops a rise in its *p*H concentration concomitantly with the progress of the inflammation.

G. M. F.

The Characters of Kupffer Cells.—J. W. Beard and P. Rous ("The Characters of Kupffer Cells Living *in vitro*," *J. Exp. Med.*, 1934, **59**, 593–608, 2 pls.). Kupffer cells from the livers of rabbit and dog cultured *in vitro* have the typical characters of clasmatocytes. Their surface is very sticky and in consequence is very difficult to handle *in vitro*. They put forth enormous pellucid circular membranes resembling those of exudate clasmatocytes, but larger. Splenic clasmatocytes, on the other hand, put forth rather small one-sided ground-glass membranes like broad tongues. When cultured on lens paper in serum they scatter on the fibres and live separately, presenting the same general aspect as when in the liver, but in the course of proliferation they lose some of their pronounced characters. A considerable population of ordinary leucocytes exists in the hepatic sinuses and during infection their number may greatly increase.

G. M. F.

The Cultivation of Kupffer Cells *in vitro*.—P. Rous and J. W. Beard ("Selection with the Magnet and Cultivation of Reticulo-endothelial Cells (Kupffer Cells)," *J. Exp. Med.*, 1934, **59**, 577–92, 3 pls.). Methods and apparatus are described for obtaining living Kupffer cells from the liver of the rabbit and dog. Almost none of these cells can be dislodged from the normal liver by forcible perfusion, but after they have taken up finely particulate matter (India ink, iron oxide) they come away in great numbers. When they have phagocyted ferromagnetic iron oxide they can be selected with a magnet from the other blood elements present in suspension and are thus obtainable in large quantities. When plated in a thin plasma clot they fail to multiply or to assume their characteristic shape; they flourish, however, when allowed to attach themselves to strands of lens paper bathed in serum that is frequently changed. Bacterial infection of serum cultures of Kupffer cells occurs regularly in cultures from animals with fever induced by the injection of nucleic acid or of killed *B. prodigiosus*. Kupffer cells obtained under such conditions are abnormally active and some can be washed out of the liver of sick animals in the absence of any preliminary phagocytosis of particulate matter. These facts have a bearing both on the conditions conducing to blood invasion and on the response of the Kupffer cells in the emergency.

G. M. F.

Spermiogenesis in the Fungus Gnat.—W. L. Doyle ("Observations on Spermiogenesis in *Sciara coprophila*," *J. Morphol.*, 1933, **54**, 477–91, 3 pls., 4 text-figs.). Neutral red stains the mitochondria in the cells of the testicle, but much less readily than Janus green B. If mitochondria are tinged with neutral red and then Janus green B is added to the staining solutions the mitochondria are stained blue-green. In preparations treated with slightly hypotonic solutions containing Janus green and neutral red numerous small granules, some red and some green, may be seen. They are usually in a cluster and in rapid agitation. These granules are not found in material fixed in formalin followed by osmication. The mitochondria appear to be covered by a lipin substance soluble in acetic acid and other lipoid solvents. The inner substance is intensely basophilic and gives the Millon reaction for proteins. G. M. F.

Chromosomes and Carcinogenic Agents.—J. C. Mottram ("Some Effects of Cancer-producing Agents on Chromosomes," *Brit. J. Exp. Path.*, 1934, **15**, 71–2,

2 text-figs.). Growing bean roots were subjected to the following agents: gamma radiation from radium, heat, a solution of tar, and a solution of gentian violet. Fragmentation of chromosomes and their delayed migration to the poles of the spindles were seen. These changes occur under many other experimental conditions such as exposure to acids, anæsthetics, high concentration of CO_2, and high osmotic pressure. G. M. F.

Arthropoda.

New French and Malagash Water Mites.—C. Motas ("Un 'Calonyx' nouveau recueilli dans les Alpes du Dauphiné," *Travaux du Laboratoire d'Hydrobiologie et de Pisciculture de l'Université de Grenoble*, 1932, **24**, année 63–73, pls. I–III, 1 text-fig.). In a collection of water mites taken at the source of the Jonnier, near Arzelier, a hamlet to the south-west of Grenoble, and sent to Prof. Motas at Jassy by the Hydrobiological Institute at Grenoble were specimens of a *Calonyx* to which he has given the name of *intermedius*. According to the author, the most salient characteristics are (1) the intermediate position which the inner edge of the third and fourth pairs of epimera occupy between those of *C. rotundus* and *C. brevirostris*, where the third pair approximate to those of *rotundus* and the fourth pair to those of *brevirostris*, and (2) the presence of triangular lobes which have their apices directed towards the middle of the genital aperture in both sexes. The second communication ("Sur deux nouveaux Hydracariens malgaches," *idem*, 75–84, 4 text-figs.) covers a collection also sent to Prof. Motas from the same Institute and which was taken in the neighbourhood of Tamatave by one of its officials seconded for service in Madagascar. Two new species are described, viz. *Hygrobates latilimbatus* and *Arrhenurus dumazeri*. The former has as an outstanding feature very wide chitinous borders to the epimera, the adjacent parts of the second and third pairs being fused together while the second species, like *A. gibbus* Koen., has three pairs of prominent tubercles on the dorsal surface, the anterior pair being united by a prominent ridge. *A. dumazeri* is distinguished from *A. gibbus* by the ridge standing erect while in the older species it leans forward. BM/HNDH

Protozoa.

Pulsation of Vacuoles in Ophryoscolecid Ciliates.—R. F. MacLennan ("The Pulsatory Cycle of the Contractile Vacuoles in the Ophryoscolecidæ, Ciliates from the Stomach of Cattle," *Univ. Calif. Publ. Zool.*, 1933, **39**, 205–50, 4 pls., 6 text-figs.). A study of the contractile vacuoles in living and fixed Ophryoscolecid ciliates belonging to the general *Ophryoscolex*, *Epidinium*, *Ostracodinium*, *Polyplastron*, *Eudiplodinium*, and *Metadinium*. The contractile vacuole of these ciliates is formed by the coalescence of small accessory vacuoles arising *de novo* in the ectoplasm and filled with the excess fluid taken in by the cytostome during the act of feeding. There is a permanent excretory pore for each vacuole opening into a canal in the pellicle. The cycle of the vacuole is formed by the resting period, systole and diastole. Successive states of gelation, solution and gelation again of the surrounding ectoplasm mark these three periods of the cycle. Osmiophilic granules (Golgi apparatus) accumulate around the vacuoles during diastole and are gradually reduced in number, being dissolved in the vacuolar fluid. This represents a method of elimination of the products of metabolism. The ectoplasm in the region of the vacuoles also contains neutral-red stainable granules (vacuome). C. A. H.

Viability of Trichomonad Flagellates.—R. HEGNER ("Passage of *Trichomonas hominis* in a Viable Condition through the Stomach and Small Intestine of a Monkey," *J. Parasit.*, 1934, **20**, 199). Large numbers of the human intestinal flagellate, *Trichomonas hominis*, were injected through a stomach tube into the stomach of a howler monkey, *Alouatta p. palliata*. The monkey was killed about 2 hours later and active flagellates were recovered from the pyloric end of the stomach and from the small intestine. The viability of the trichomonads under these conditions suggests that they can pass into the human alimentary tract in a similar manner, since in the absence of cysts the only conceivable method of infection is through contaminated food or drink. C. A. H.

List of Isospora Species.—E. R. BECKER ("A Check-list of the Coccidia of the Genus *Isospora*," *J. Parasit.*, 1934, **20**, 195–96). A complete up-to-date list is given of the species of the coccidian genus *Isospora*, which contains all the specific names, authors' names, date of naming, range in size of the oocyst and the known hosts. C. A. H.

Locomotion in Amœba.—R. F. PITTS and S. O. MAST ("The Relation between Inorganic Salt Concentration, Hydrogen Ion Concentration, and Physiological Processes in *Amœba proteus*. I. Rate of Locomotion, gel/sol Ratio, and Hydrogen Ion Concentration in Balanced Salt Solutions," *J. Cell. and Comp. Physiol.*, 1933, **3**, 449–62, 1 fig.). A description of investigations of the rate of locomotion and gelation in *Amœba proteus* in relation to the hydrogen ion and salt concentrations in different salt solutions. The amœbæ were grown in Chalkey solution (80 mgm. NaCl, 4 mgm. $NaHCO_3$, 4 mgm. KCl, 4 mgm. $CaCl_2$, 2 mgm. $CaH_4(PO_4)_2$, 2 mgm. $Mg_3(PO_4)_2.4H_2O$, and H_2O to 1 litre) containing rice, at *p*H 6·6. Variations in hydrogen ion concentration were obtained and maintained by phosphate buffers, the *p*H in the series ranging from 5·0 to 8·0. The amœbæ, in batches of about 500, were placed in watch glasses, washed, and removed into about 5 c.c. of the solution under observation. A constant temperature of about 23° C. was maintained by means of a bath. As the acidity decreases the rate of locomotion of amœba in a balanced salt solution increases to a maximum at *p*H 6·2, then decreases to a minimum at *p*H 7·0, then again increases to a second maximum at *p*H 7·5, after which it falls to zero at *p*H 8·0. The rate of locomotion throughout the entire range of hydrogen ion concentrations tested varies inversely with the salt concentration. The gel/sol ratio varies directly with the acidity and with the salt concentration, i.e. the higher the *p*H and the salt concentrations, the more plasmagel in relation to plasmasol. C. A. H.

Parasitic Infusoria in Sea-Urchins.—M. UYEMURA ("Über einige neue Ciliaten aus dem Darmkanal von japanischen Echinoideen. I," *Sci. Rep. Tokyo Bunrika Daigaku* (Sect. B), 1934, **1**, no. 17, 181–91, 6 figs.). Description of two new trichostomatous holotrichous ciliates parasitic in the intestinal tract of a number of species of sea-urchins from the coasts of Japan. *Entorhipidium fukuii* sp.n. occurs in *Anthocidaris crassispina*, *Pseudocentrotus depressus*, *Strongylocentrotus pulcherrimus*, *S. intermedius*, and *Glyptocidaris crenularis*. This ciliate measures 114μ × 34μ; ratio of length to breadth ca. 3·3 : 1; macronucleus oval, central, with micronucleus close to it. What appears to be a contractile vacuole lies in the posterior end of the body. *Conchophthirus striatus* sp.n. measures 89μ × 57μ, the ratio of length to breadth being ca. 3 : 2. Contractile vacuole absent. Spherical macronucleus almost central, with micronucleus anteriorly to it. C. A. H.

Vacuome in Vorticellids.—H. E. Finley ("On the Vacuome in Three Species of *Vorticella*," *Trans. Amer. Micr. Soc.*, 1934, **53**, 57–64, 1 pl.). Description of the osmiophilic, argentophile, and neutral-red stainable cytoplasmic inclusions, also known as "vacuome," in *Vorticella convallaria*, *V. microstoma*, and *V. campanula*. In unstained specimens of these ciliates were found discrete globular inclusions measuring $0{\cdot}5\mu$–$0{\cdot}7\mu$ in diameter, which appear to be preformed and are consistently impregnated by recognized osmic and silver methods; they can be distinguished from the rod-shaped mitochondria by vital staining with a mixture of Janus green B and neutral red. On the other hand, it has been demonstrated that neutral red is not specific for the vacuome in the three species of *Vorticella*. C. A. H.

Method for counting Infusoria.—F. O. Atchley and W. W. Swezey ("A Method for the Enumeration of Ciliate Protozoa," *Trans. Amer. Micr. Soc.*, 1934, **53**, 35–9). The following method was used for determining the number and distribution in the fæcal specimens of two parasitic ciliates from the intestine of the chimpanzee, *Troglodytella abrassarti* and *Balantidium coli*. The procedure, which is an adaptation of Stoll's method for counting helminth eggs, is as follows: 6 c.c. of fixative (80 p.c. Dobell's iodine + 20 p.c. solution formaldehyde) are measured into a Stoll flask; Ringer's fluid is added up to 56 c.c. mark; enough fæcal matter is introduced to raise the fluid to 60 c.c.; eight to ten small glass beads are added, and the flask is tightly stoppered and violently shaken in order to break up the fæces. About 24 hours later the shaking is repeated, and a 0·075 c.c. sample of the suspension is removed with a Stoll pipette. The organisms in the drop are counted under a 22 × 30 mm. coverslip. C. A. H.

Coccidia of the Genus Caryospora.—C. A. Hoare ("On the Systematic Status of *Eumonospora tremula* Allen, 1933 (Coccidiida Eimeriidæ)," *Trans. Amer. Micr. Soc.*, 1934, **53**, 6–7). Since *Eumonospora tremula*, a new genus and species of coccidia created by Allen, 1933 [*cf.* abstract in *J. Roy. Micr. Soc*, vol. LIII, pt. 4, p. 341], corresponds in all the essential particulars with the three known species of the genus *Caryospora* it is transferred to the latter genus, its name being emended to *Caryospora tremula* (Allen, 1933) Hoare, 1934. A table is provided giving the differential diagnosis of the four species of *Caryospora*. C. A. H.

Avian Coccidia.—E. A. Allen ("*Eimeria angusta* sp. nov. and *Eimeria bonasæ* sp. nov. from Grouse, with a Key to the Species of *Eimeria* in Birds," *Trans. Amer. Micr. Soc.*, **53**, 1934, 1–5, 1 pl.). A description is given of two new coccidia from North American grouse: (1) *Eimeria angusta* sp.n. from the cæca of *Bonasa umbellus* and *Canachites canadensis*, is characterized by oocysts measuring $16{\cdot}5\mu$–$17{\cdot}5\mu$ by 27μ–33μ, provided with an "operculum"; (2) *E. bonasæ* sp.n. occurs in the cæca and rarely in the small intestine of *Bonasa umbellus* and *Lagopus lagopus*; its oocysts measure about 21μ in diameter and are devoid of an "operculum" or micropyle. A useful key is provided for the identification of species of *Eimeria* described from birds. C. A. H.

Atypical Forms of Bartonella and Eperythrozoon.—J. Schwetz ("Sur *Eperythrozoon coccoides*; sur des infections mixtes à *Eperythrozoon coccoides* et à *Bartonella muris*, et sur des formes bizarres et énigmatiques trouvées chez les rats et les souris sauvages de Stanleyville," *C. R. Soc. Biol.*, 1934, **115**, 408–11). The author describes various forms of *Bartonella muris* and *Eperythrozoon coccoides* encountered in the blood of rats in the Congo. One splenectomized rat had a pure infection with small coccoid forms of *Eperythrozoon*, while in another rat this

parasite appeared in the form of rings, shells, and discs together with *Bartonella;* in a third rat the last-named parasite was again associated with *Eperythrozoon*-like structures in the form of bacilli, commas, etc. Among other rats suffering from bartonellosis there appeared rare forms similar to *Eperythrozoon.* There does not appear to be a strictly defined border-line separating the two types of parasite, nor is the classification of *Eperythrozoon* yet firmly established. C. A. H.

Tropical Pacific Foraminifera.—J. A. CUSHMAN ("The Foraminifera of the Tropical Pacific Collections of the *Albatross*, 1899–1900. Part 2. Lagenidæ to Alveolinellidæ," *U.S. Nat. Mus.*, Bull. **161**, 1933, i–vi, 1–79, pls. 1–19). Contains descriptions of eight new species and one new variety chiefly from shallow water among the islands. The evidence points to the fact that many species are very localized in their distribution about the various oceanic islands, and probably a careful survey of the different island groups will show that there are many of these isolated species and varieties that have not yet been recognized, but are often to be found in great numbers. Over thirty species or varieties of *Lagena* are described and figured from the tropical area, but they include very few of the peculiar forms recorded by Sidebottom from the South Pacific, so that it would appear that these two areas represent separate zoological regions. The illustrations are excellent.
A. E.

Californian Miocene.— J. A. CUSHMAN and R. M. KLEINPELL ("New and Unrecorded Foraminifera from the Californian Miocene," *Cont. Cush. Lab. For. Res.*, 1934, X, no. 140, 1–23, pls 1–3 and 4, figs. 1–5). Describes and figures a large number of new species and varieties from various Californian localities.
A. E.

More New Species.—J. A. CUSHMAN and E. W. GALLIHER ("Additional New Foraminifera from the Miocene of California," *Cont. Cush. Lab. For. Res.*, 1934, X, no. 141, 24–6, figs. 6–12 on pl. 4). Five additional new species and two new varieties from the Miocene of various Californian localities. A. E.

Fossil Foraminifera from the Gobi Desert.—J. J. GALLOWAY and L. E. SPOCK ("Pennsylvanian Foraminifera from Mongolia," *Amer. Museum Novitates*, 1933, no. 658, 1–6, 1 pl, sketch map). The Foraminifera are described by J. J. Galloway from sections of a single specimen of limestone of middle Pennsylvanian age, collected from an outcrop in Inner Mongolia. They establish the existence of marine rocks of Pennsylvanian age in the Gobi, and add a new chapter to palæozoology. Six species have been identified, belonging to as many genera, *Endothyra Bradyina, Globivalvulina, Tetrataxis, Climacammina,* and *Schubertella.* None is new, most of them are known from rocks of similar age in China, and several from the same horizon in Russia and North America. A. E.

Jurassic Foraminifera.—J. R. SANDIDGE ("Foraminifera from the Jurassic in Montana," *Amer. Midland Naturalist,* 1933, **14**, (2), 174–85, pl. 1, 2 text-figs.). Foraminifera were found in two zones only, near the top and bottom respectively of the Sundance formation (Jurassic) which is approximately 510 feet thick. They are all calcareous forms belonging principally to the Lagenidæ, *Lenticulina, Vaginulina,* and *Frondicularia* being the chief genera represented. Most of the species show relationship with the fauna described by Terquem from the Bajocien (Lower Oolite) of France. The author points out the significance of a fauna in the North American Jurassic corresponding in many respects with material

described from the Jurassic of France, but in view of the confused state of the nomenclature refrains from making any new species, on which he is to be congratulated. Twelve species are described and adequately figured. A. E.

Canadian Jurassic.—R. T. D. WICKENDEN ("Jurassic Foraminifera from Wells in Alberta and Saskatchewan," *Trans. Roy. Soc. Canada*, ser. 3, sect. 4, 27, 1933, 157–70, pls. 1–2). The three wells from which material was obtained contained practically the same fauna, which is very similar to one described by Sandidge from the Sundance formation in S.E. Montana, and determined by him to be Bajocien. The Canadian fauna is about the same age, for nearly all the species compare with those found in the Dogger of Central Europe, and Bajocien of France. The majority of species belong to the Lagenidæ. It may be possible to divide the Jurassic microfaunas of the Prairies into well-defined zones, as practically the same succession of species was found in all three wells. There are no new species. A. E.

Tertiary of Venezuela.—D. W. GRAVELL ("Tertiary Larger Foraminifera of Venezuela," *Smithsonian Misc. Coll.*, 1933 (3223), **89**, no. 11, 1–44, pls. 1–6). The strata examined range from Pliocene to ? Middle Eocene age. Down to the Upper Oligocene the only large species recorded was *Amphistegina lessonii*, which has no value for inter-regional correlation. The Upper Oligocene or Agua Clara series yielded the same species and indeterminable species of *Amphisorus* and *Lepidocyclina*, but they do not present sufficient palæontological evidence to determine definitely the stratigraphic age of the material. The Middle Oligocene or San Luis series yielded a number of large forms of *Heterostegina*, *Lepidocyclina*, and *Miogypsina*, and may be correlated with the lower part of the Antigua formation of the West Indies which contains a similar fauna, with the Oligocene of Panama and Jamaica, and the Meson formation of Mexico. The Lower Oligocene of the Buena Vista anticline contained abundant *Amphistegina*, *Camerina*, and *Heterostegina*, but these shed no light on the stratigraphic position of the nummulitic limestone containing them. The Guayaval series of the Upper Eocene yielded several species, *Discocyclina*, *Lepidocyclina*, *Camerina*, *Gypsina*, and *Operculina*, and is of the same age as similar formations in Panama and Jamaica. It may be considered the equivalent of the Ocala limestone of Florida, Georgia, and Alabama, and part of the Lobitos shales of N.W. Peru The greater portion of the material was indurated, and could only be studied in thin sections, for which reason specific determination was often impossible. Four new species only are described, *Heterostegina panamensis*, *D.* (*Asterocyclina*) *kugleri*, *L.* (*Lepidocyclina*) *saulnisensis*, and *Miogypsina bramlettei*. The photographic illustrations are not too clear. A. E.

Correlation of Living and Fossil Foraminifera.—M. L. NATLAND ("The Temperature and Depth-Distribution of Some Recent and Fossil Foraminifera in the Southern California Region," *Bull. Scripps Inst. Ocean.* (*Technical Ser*), 1933, **3**, no. 10, 225–30, 1 table). An enormous table sets out (1) the bathymetric and temperature ranges of some recent Foraminifera collected between San Pedro and Santa Catalina Island, California, and a few additional off-shore stations ranging down to 1390 fathoms; (2) the stratigraphic ranges of these species in a section of marine sediments exposed in Hall Canyon, Ventura, California. Many of the species found in the sedimentary section are now living in the adjacent sea, and knowledge of their environmental conditions should make it possible to deduce the conditions under which the deposits were laid down. The Foraminifera have been divided into five faunal zones according to depth and bottom temperature; the "abundant" species in each zone are listed. A comparison of the tables (1) and

(2) prove, according to the author, that dissimilar faunas may be contemporaneous, and conversely, the correlation of two widely separated outcrops, based on similarity of their foraminiferal fauna alone, is apt to be erroneous. The resemblance of two faunas indicates similar environments but not necessarily contemporaneity.
A. E.

Texas "Jackson" Foraminifera.—A. C. Ellisor ("Jackson Group of Formations in Texas with Notes on Frio and Vicksburg," *Bull. Amer. Assoc. Petroleum Geol.*, 1933, **17**, no. 11, 1293–1350, pls. 1–7, 8 text-figs.). This, a purely geological paper, is of interest to the microscopist as including lists of the Foraminifera found in the various formations into which it is proposed to subdivide the Jackson (Upper Eocene) of Texas. There is also a check list of Jackson species with the divisions in which they occur, and seven admirable plates of characteristic species.
A. E.

Gypsina and the Stromatoporoids.—S. J. Hickson ("On *Gypsina plana*, and on the Systematic Position of the Stromatoporoids," *Q. J. Micr. Sci.*, 1934, **76** (3), 433–80, pls. 26–7, 13 text-figs.). Dead branches of a madrepore collected in shallow water at Tahiti were almost covered with a thin crust of *Gypsina* having an area to be measured in square inches, and varying much in structure. A detailed study has convinced the author that the organism forming the crust is identical with *Gypsina plana* Carter, a species with a very wide distribution in warm seas, that the differences in structure are correlated with differences of environment, and that possibly all the known species of *Gypsina* are but modifications of this species. In a separate section of the paper the author revives the old controversy as to the nature of the Stromatoporoids. He refuses to accept them as Hydrozoa, and points out many features which they have in common with Foraminifera, to which order he considers that they belong. He points out that our knowledge of the large reef-forming species of Foraminifera has been greatly extended since the great controversy as to the nature of the Stromatoporoids 50 to 60 years ago, and that Carpenter, Dawson, and others who supported the view as to their foraminiferal relations, were hampered by the absence of knowledge which we now possess. Professor Hickson evidently holds very strong views on a subject which, as an authority on the Hydrozoa, he is well able to discuss, and it will be interesting to see whether he succeeds in reviving the controversy.
A. E.

Arctic Foraminifera.—J. A. Cushman ("New Arctic Foraminifera Collected by Capt. R. A. Bartlett from Fox Basin and off the North-east Coast of Greenland," *Smithsonian Misc. Coll.*, 1933 (3221), **89**, no. 9, 1–8, 2 pls.). A preliminary paper describing ten new species and varieties, pending publication of a report on forty-six genera and nearly 100 species of Foraminifera found in bottom samples from N.E. Greenland and Fox Basin in Baffin Land. The most interesting feature is the discovery in the Arctic of two new species of genera only recently described from Antarctic waters, *Gordiospira* Heron-Allen and Earland, 1932, and *Urnula* Wiesner, 1931. The author is mistaken in suggesting that *Sorosphæra depressa* Heron-Allen and Earland, described and figured in this Journal in 1929 (**49**, 102, pl. I, figs. 1, 2) should be transferred to *Urnula*. The two organisms have little in common.
A. E.

Ultramicroscopic Viruses.

Cultivation of Typhus Rickettsiæ.—S. Zia ("The Cultivation of Mexican and European Typhus Rickettsiæ in the Chorio-allantoic Membrane of the Chick

Embryo," *Amer. J. Path.*, 1934, **10**, 211–8, 1 pl.). Both Mexican and European typhus Rickettsiæ are able to infect the chorio-allantoic membrane of the chick embryo. As a result the number of cellular elements in the mesothelial layer is increased, the endodermal lining is slightly thickened, and the number of cellular elements in the mesothelial layer is much increased forming small nodules made up of very degenerated mononuclear cells and often many cells containing coarse eosinophilic granules. The majority of the Rickettsiæ are found in the degenerated outer layer of the ectodermal lining. G. M. F.

Cytoplasmic Inclusions produced by Alastrim in Rhesus Monkeys.—C. M. TORRES and J. DE C. TEIXEIRA ("Estudo comparativo das inclusões do alastrim e da vacina no macaco (*Macacus rhesus*)," *Mem. Inst. Oswaldo Cruz*, 1934, **28**, 181–92, 4 pls.). Vesicles and pustules may be produced in the skin of rhesus monkeys by intravenous inoculation of alastrim virus. Cytoplasmic inclusions are found within the epidermal cells. Alastrim virus was less virulent than vaccinia virus. After fixation in Helly's fluid and staining with alum hæmatoxylin and eosin there are definite differences between alastrim inclusions and those due to vaccinia. In alastrim in the early stages there are from two to four inclusion bodies which fuse together in the later stages Alastrim bodies stain deep blue to greyish-blue, though in necrotic epidermal cells they sometimes exhibit pink staining. Vaccine bodies in the latter stages are multiple in each cell and regularly present a characteristic polychromatophilia. G. M. F.

Changes in the Salivary Glands in Rabies.—H. E. SHORTT and B. N. LAHIRI ("Morphological Studies on Rabies. Part I. The Salivary Glands," *Ind. J. Med. Res*, 1934, **21**, 587–604, 2 pls.). A study of rabic material from dog, monkey, and man shows that while characteristic appearances are found in the salivary glands of rabid animals these are in most cases the results of an exaggerated physiological response of the glands to hyper-stimulation and do not necessitate the specific presence of a living virus, although this is probably the cause of the stimulation in rabies. No evidence was obtained of the visible presence of any bodies which could be identified as bacteria, protozoa, or filterable viruses. Certain eosinophilic bodies found in connective tissue cells and very similar to those found in infectious ectromelia can be produced by the use of pilocarpine and are considered as coagulated secretion or its precursor. G. M. F.

Equine Encephalomyelitis.—E. W HURST ("The Histology of Equine Encephalomyelitis," *J. Exp. Med.*, 1934, **59**, 529–42, 4 pls.). The virus of equine encephalomyelitis (eastern strain) evokes in the horse, calf, sheep, and dog an unusually intense encephalomyelitis characterized by acute primary degeneration of nerve cells, the appearance in neurones of the brain stem and elsewhere of nuclear inclusions resembling those in Borna disease and poliomyelitis, polymorphonuclear infiltration in the nervous tissues with early microglial proliferation, perivascular cuffing with mononuclears and polymorphonuclears in varying proportions. The grey matter is affected more than the white. Lesions may be less marked in the striatum, brain stem, and cord than in the cerebral cortex, thalamus, and hypothalamic region and are always of low grade in the cerebellum. Meningeal infiltration is secondary. In the guinea-pig, rabbit, and mouse, the eastern virus causes an acute encephalomyelitis, which as is usual in neurotropic virus diseases of these lowly species has a special tendency to affect the higher olfactory centres. In addition to inclusions in the nerve cells, tiny oxyphilic bodies occur with less frequency in the glial and mesodermal nuclei of the guinea-pig. G. M. F.

Propagation of the Virus of Infectious Laryngotracheitis of Fowls.—F. M. Burnet ("The Propagation of the Virus of Infective Laryngotracheitis on the Chorio-allantoic Membrane of the Developing Egg," *Brit. J. Exp. Path.*, 1934, **15**, 52–5, 1 pl.). Laryngo-tracheitis virus of fowls may be propagated in the chorio-allantoic membrane of the developing egg. The lesions produced in the membrane are primarily due to proliferative changes in the ectodermal layers followed by necrotic lesions. Proliferating cells show typical intranuclear changes similar to those found in the tracheal lesions. A large deeply staining nucleolus seems to be characteristic of infected nuclei in the earliest stage. The inclusion develops alongside this, and as it enlarges, appears to push the nucleolus over to the nuclear membrane. The fully developed inclusions are present at the time when the proliferating epithelium begins to undergo vacuolation and necrosis. The inclusion occupies the central region of the nucleus and covers from a third to a half of its area, an empty space lying between it and the nuclear membrane, on which are piled up the remains of the nucleolus and the chromatin of the nucleus. In a later stage still, where the cells are apparently dead and are being removed by inflammatory cells, the nuclei are shrunken and the acidophilic mass fills the whole nucleus. G. M. F.

Differentiation of the Viruses of Fowl Plague and Newcastle Disease.—F. M. Burnet and J. D. Ferry ("The Differentiation of the Viruses of Fowl Plague and Newcastle Disease: Experiments using the Technique of Chorio-allantoic Membrane Inoculation of the Developing Egg," *Brit. J. Exp. Path.*, 1934, **15**, 56, 1 pl.). Newcastle disease virus produces a characteristic lesion in the chorio-allantoic membrane, in which cytoplasmic inclusions can be demonstrated histologically. Filtration studies indicate that Newcastle disease virus is larger (80–120 mμ) than fowl plague virus (60–90 mμ). Newcastle disease virus is also more resistant to the photodynamic action of methylene blue than fowl plague virus. G. M. F.

BOTANY.

(*Under the direction of* A. B. Rendle, M.A., D.Sc., F.R.S.)

Anatomy and Morphology.

Occurrence of Vessels in Selaginella.—H. Duerden ("On the Occurrence of Vessels in *Selaginella*," *Ann. Bot.*, 1934, **48**, 459–65, 1 pl.). In *Selaginella oregona* Eaton, *S. rupestris* Spring, *S. eremophila* Maxon, *S. densa* Rydb., *S. Underwoodii* Hieron., *S. arizonica* Maxon, *S. Hansenii* Hieron., and *S. Bigelowii* Underw., the xylem consists mostly of vessels, though some pointed tracheids also occur. In *S. rupinicola* Underw. true vessels are rarely present, the xylem for the most part being made up of pointed tracheids, as well as some with rounded ends. In *S. spinosa* the xylem is entirely tracheidal in nature. The above species are all homophyllous. In the heterophyllous species, *S. chrysorhizos* Spring, *S. chrysocaulos* Spring, *S. pallidissima* Spring, *S. Victoriæ* Moore, and *S. grandis* Moore, the xylem is also entirely tracheidal. B. J. R.

Development of Resin Cysts in Tsuga canadensis.—M. W. Bannan ("Vigour of Growth and Traumatic Resin Cyst Development in the Hemlock, *Tsuga canadensis* (L.) Carr.," *Trans. Roy. Soc. Canada*, 1933, **27**, 197–202). The causal factor in the development of resin cysts in the hemlock is cambial injury. Vigour of growth is a subsidiary factor contributing to an increased production of traumatic resin tissue. In branches with wide annual rings more numerous cysts result from injury than in slow-growing branches. The differences between laterals and leaders, or between branches on different parts of the tree, are correlated with the variations in ring-width. B. J. R.

Distribution of Resin Canals in the Wood of Larix laricina.—M. W. Bannan ("Factors Influencing the Distribution of Vertical Resin Canals in the Wood of the Larch, *Larix laricina* (Du Roi) Koch," *Trans. Roy. Soc. Canada*, 1933, **27**, 203–18, 1 pl., 1 fig.). Vertical resin canals are almost entirely lacking from the wood of seedlings growing in protected localities and hence free from injury. Seedlings showing evidence of injury have more abundant canals which are clearly correlated with the wounds. A similar distribution of resin canals is found in the branches of both old and young trees. Vigour of growth is of importance in the development of canals, but as a subsidiary rather than an initiating factor. Canals are sometimes associated with physiological disturbances to the cambium, such as those due to pressure, which have in some cases not been intensive enough to produce open injury. The increase in canals in the first year of the stem leader or main branches may be due to pressure induced by movement. Canals were observed in association with injuries of all types except frost rings. B. J. R.

Wood Structure of the Meliaceæ.—A. J. Panshin ("Comparative Anatomy of the Woods of the Meliaceæ, sub-family Swietenioideæ," *Amer. J. Bot.*, 1933, **20**, 638–68, 12 pls.). The anatomical features common to the sub-family are summarized. The general characteristics and minute anatomy of the woods are

described and figured with photomicrographs, and the diagnostic characters of the species are clearly defined. A key to the genera of the group, based on their wood anatomy, is included. The wood structure of each genus is characteristic and fairly constant with the exception of *Entandrophragma;* examination of this genus shows that the species fall into four groups, corresponding fairly closely with the four sub-genera established by Harms on the basis of morphological characters. B. J. R.

Comparative Anatomy of the Genus Typha.—F. J. MEYER (" Beitrage zur vergleichenden Anatomie der Typhaceen (Gattung *Typha*)," *Beih. bot. Centralb.*, 1933, **51**, Abt. 1, 335–76, 21 figs.). Owing to the scanty information concerning the anatomy of the genus *Typha*, the author made a comparative anatomical study of the vegetative parts of *Typha latifolia* L., *T. Laxmanni* Lepechin, *T. angustifolia* L., and *T. minima* Funk In most of the paper a very detailed account of the anatomy of the leaf, rhizome, and aerial axis (including the inflorescence region) and root of *T. angustifolia* is given, whilst the other species are dealt with in five and a half pages. The investigation showed that there is very close agreement in the structure of the four species selected for study. *T. minima*, however, differs from the others in having no sclerenchymatous sheath surrounding the central cylinder in the aerial stem. The most useful feature for distinguishing the species is the characteristic shape of transverse sections of the leaf taken at the transition region between the leaf-sheath and lamina. The epidermis of all the organs was very similar, especially as shown by the arrangement of the cells in regular rows, the distribution of the stomata, the absence of trichomes, and the occurrence of mucilage glands on the inner side of the leaf-sheath. There are, however, characteristic differences in the mucilage glands of the four species. The tissues of the axis and root in the different species can be distinguished only by minor differences in size. The cell contents in the different organs of all the species are similar and consist chiefly of myriophyllin and calcium oxalate. The latter is chiefly in the form of plate-like crystals in the idioblasts of the diaphragms, and styloids associated with the fibre bundles. Variations in structure which were observed at different levels in one single plant organ are fully described.
C R. M.

Biology and Physiological Anatomy of some Indian Halophytes.—D. P. MULLAN (" Observations on the Biology and Physiological Anatomy of some Indian Halophytes," *J. Ind. Bot. Soc.*, 1933, **12**, 235–53, 10 pls). This paper is one of a series, of which previous parts have been noticed, in which the anatomy of some Indian halophytes is described. The present paper consists of detailed anatomical descriptions of the vegetative parts of the following species: *Leucas aspera* Spreng. (Labiatæ), *Boerhaavia diffusa* L. (Nyctaginaceæ), *Celosia argentea* L. (Amarantaceæ), *Sesuvium portulacastrum* L (Ficoideæ), *Suæda nudiflora* Moq. (Chenopodiaceæ), and *Arthrocnemum indicum* Moq. (Chenopodiaceæ). The possible physiological significance of the anatomy of the plants is discussed, and the structure of halophytic and mesophytic forms of some of the individual species is contrasted. C. R. M.

Thorn-like Roots of Bridelia pubescens Kurz.—P. PARIJA and P MISRA (" The Root-thorn of *Bridelia pubescens* Kurz," *J. Ind. Bot. Soc.*, 1933, **12**, 227–33, 2 pls.). *Bridelia pubescens* Kurz, a tree belonging to the Euphorbiaceæ, produces thorns growing at right angles to the main trunk and also at the bases of the branches. Longitudinal sections show that these thorns are provided with a many-layered root-cap at the apex. Young thorns show a polyarch structure

resembling that of a monocotyledonous root. The structure thus indicates that the "thorns" are morphologically roots. Normal subterranean roots of *Bridelia pubescens* differ from the thorn roots in having only four to six xylem groups. Secondary growth takes place when a cambium is formed in the way that is usual in ordinary dicotyledonous roots. The phellogen, however, arises in the outermost cells of the cortex, thus differing from the phellogen of the normal roots which arises in the pericycle. Numerous tannin-containing cells are formed in all the tissues between the phlœm and the phellogen "when the root has reached a certain age." The rate of growth of the root-thorns increases somewhat if they are darkened, and covering them with soil accelerates the rate of growth considerably. The authors believe that root-thorns are apogeotropic, and that a humid atmosphere is essential for their growth. Light is stated to have no influence on their direction of growth. C. R. M.

Anatomy, Development, and Regeneration of the Flax Seedling.—D. M. Crooks ("Histological and Regenerative Studies of the Flax Seedling," *Bot. Gaz.*, 1933, **95**, 209–39, 44 figs.). The primary root of *Linum usitatissimum* is diarch. The histogens at the growing point are clearly defined and consist of the plerome, periblem, and calyptrogen which give rise to the stele, cortex, and root-cap respectively. The first vascular elements which develop in the root are two primary phloem strands, which are formed from single rows of cells lying next to the pericycle. The protoxylem groups, which alternate with the phloem groups, are not differentiated until later on. Lateral roots have their origin in the pericycle. Certain cells divide tangentially to form two layers of cells which themselves divide and give rise to four layers of cells of which the outer differentiates to form the calyptrogen and dermatogen, the second the periblem, whilst the two innermost give rise to the plerome. When lateral roots are formed the endodermis gives rise to a single layer of meristematic cells overlying the root-cap. The primary vascular system of the root, hypocotyl and cotyledons is stated to form a system which is more or less independent of the later epicotyledonary development. The vascular tissues connecting the epicotyl and hypocotyl are mostly secondary. All the vascular bundles of the epicotyl are collateral foliar bundles which, without anastomosing, end in the parenchyma between the other vascular bundles. The development of the epicotyl and foliage leaves is described. In the upper region of the hypocotyl most of the primary xylem is broken down by elongation. When seedlings were severed in the middle of the hypocotyl the part of the seedling below the cut gave rise to five to twenty buds of which usually only one developed into a shoot. The new buds thus formed, which originated by successive divisions of the epidermal cells, are connected to the primary stele of the hypocotyl by vascular tissue which is formed by renewed cell-division in the cortex, endodermis, pericycle, phloem-parenchyma, and cambium. The upper parts of the seedlings severed in the middle of the hypocotyl if placed under suitable conditions produce adventitious roots. If cotyledons are removed from seedlings and placed on moist soil, a layer of parenchymatous cells on the adaxial side of the larger veins gives rise to adventitious roots. The severed cotyledons were found to be capable of living for two months, but in no instance produced shoots. C. R. M.

Gummiferous Apparatus of Sterculia platanifolia L.—G. Gazet du Chatelier ("De l'appareil gommifère du *Sterculia platanifolia* L.," *Bull. Soc. Bot. Fr.*, 1934, **81**, 62–6, 1 fig.). Whilst Trécul attributed the gum-reservoirs of the Sterculiaceæ to a lysigenous origin, Van Tieghem, Dumont, and Gerard considered them to be schizogenous. Later Doussot considered that both processes

may take place simultaneously. In *Sterculia platanifolia*, and probably in the rest of the Sterculiaceæ, gum is formed in certain parenchymatous cells whose protoplasm undergoes a total transformation in the course of development. The eventual dissolution of the membranes of these cells results in the fusion of the gummy elements with each other and in the formation of large gum-pockets or gummy pseudo-canals in the old tissues of the plant. The method of formation must thus be considered solely lysigenous. Thus the Sterculiaceæ in this, as well as in many other well-known characters, approach the Malvaceæ even more closely. A. W. E.

Comparative Anatomy of the Genus Meconopsis.—J. FRIEDEL ("Quelques observations sur l'anatomie comparée du genre *Meconopsis* Viguier. Contribution a l'étude de la filiation des Papaveracées," *Bull. Soc. Bot. Fr.*, 1934, **81**, 103–6). The author studied the anatomy of the stem of nine species of *Meconopsis* finding a great uniformity of structure except in the case of *M. chelidonifolia* Bur. & Franch. The vascular bundles are in a single circle and are clearly separated from each other, as in all the Papaveraceæ, except *Oceanopapaver*. Xylem and phloem are superposed and do not show the V-form. The number of bundles varies according to the species and at different levels in the same species. *M. chelidonifolia* shows a special structure in having the epidermis and cortex as much sclerified as the pericycle region and the V-shaped xylem is more accentuated than in the Ranunculaceæ. It is in fact a monocotyledonous structure except that the bundles are arranged in a single ring. In the light of these observations the author discusses whether evolution in the Papaveraceæ has been progressive or regressive. Without coming to a definite conclusion he favours the latter hypothesis and considers that *Meconopsis chelidonifolia* represents an archaic type.
A W. E.

Seedling Anatomy of Gossypium.—A. M SPIETH ("Anatomy of the Transition Region in *Gossypium*," *Bot. Gaz.*, 1933, **95**, 338–47, 10 figs.). In this paper a detailed account is given of the anatomy of the transition region in seedlings of the cotton plant (*Gossypium hirsutum* L.). Since the details are somewhat difficult to follow they cannot easily be summarized, but are best studied in the original paper. C. R. M.

Anatomy and Development of the Onion.—C A. HOFFMAN ("Developmental Morphology of *Allium Cepa*," *Bot. Gaz*, 1933, **95**, 279–99, 29 figs.). The primary root of *Allium Cepa* L. is diarch, and at its growing point there are two histogens of which the inner gives rise to the stele, and the outer to the remainder of the root. The adventitious root, which is usually pentarch, originates in the pericycle of the stem at the level of the apical meristem. Details of the transition from the exarch to the endarch xylem in the lower part of the stem are given. "The stem consists of a parenchymatous cortex, a stele which contains branched and anastomosed amphivasal vascular bundles in a groundwork of parenchyma, and a central pith surrounded by a cylindrical network of bundles to which most of the leaf-traces are connected." The mode of development of the leaf and the formation of guard cells and stomata are described. Longitudinal rows of lacticiferous cells are present in the leaf not far beneath the surface. The structure of the mature onion bulb is described. C. R. M.

Anatomy of Drought- and Heat-resisting Leaves.—B. KELLER ("Über den anatomischen Bau durre- und hitzerresistenter Blatter," *Ber. Deutsch. Bot. Ges.*, 1933, **51**, 514–22. 5 figs.). An account of the anatomy of the leaves of the

desert plants *Rosa persica* Michx., *Psoralea drupacea* Bge., and *Sophora alopecuroides* L. A characteristic feature of all the leaves is the unusually great length of veins per unit area of leaf surface. The frequency of the stomata is also high. The cuticle is not especially thick on any of the leaves. In *Rosa persica* a considerable proportion of the leaf thickness is made up by the very large, mucilage-containing epidermal cells. The inner tissues of the leaf are very compact, and there are palisade cells on both sides. The leaves of *Rosa persica* differ from those of most species of this genus in having small simple leaves which are very hairy on the upper side. The cells of the upper epidermis of *Sophora alopecuroides* are remarkable for containing large numbers of sphæro-crystals of an hesperidin-like substance. The leaves of *Sophora* are covered with small white adpressed air-containing hairs. The leaves of *Psoralea drupacea* are strongly scented. This is due to the presence of numerous secretory cavities just below the upper surface of the leaf. The outer walls of the epidermal cells are thick. The stomata are only very slightly sunken. C. R. M.

Occurrence of Cuticle within the Leaves of Dicotyledonous Plants.—T. Arzt ("Untersuchungen uber das Vorkommen einer Kutikula in den Blattern dikotyler Pflanzen," *Ber. Deutsch Bot. Ges.*, 1933, **51**, 470–500, 5 figs.). The author observed that, in the leaves of a very wide range of families of dicotyledons which he studied, there is always cuticle present in places where the cells of the lower epidermis are bounded by intercellular spaces These cuticular layers are described as inner cuticles in order to distinguish them from layers of cuticle present on the external surfaces of plant organs. In a number of instances similar layers of cuticle were observed in the small intercellular spaces between the cells of the upper epidermis and the palisade layer. In most cases the inner cuticle extends for short distances along the walls of the spongy parenchyma cells adjacent to the epidermis. In a few species (especially *Populus nigra*) the inner cuticle is especially well developed so that the substomatal cavities and all intercellular spaces near the epidermis are lined with cuticle. There are also other species in which the inner cuticle is so thin that it can be recognized only as a sharply defined line on the inner side of the epidermal cells It is stated that these dark lines were, with very few exceptions, not observed around other cells. There were a few species in which no inner cuticle was seen, but the author believes that this was because the stain employed was ineffective in making the cuticle evident. It is suggested that an inner cuticle is probably present in the leaves of all plants. C. R M.

Method of Investigating the Distribution of Stomata by Collodion Films.—F. L. Long and F. E. Clements ("The Method of Collodion Films for Stomata," *Amer. J. Bot.*, 1934, **21**, 7–17, 1 fig). In connection with ecological and other botanical work it is frequently desirable to make accurate counts of the number and distribution of stomata on large numbers of leaves Hitherto this has been done chiefly by making microscopical preparations of strips of the epidermis, or by direct observation of the leaf-surfaces. Both these methods are unsatisfactory when it is necessary to examine the whole of both surfaces of a large number of leaves. In this paper the authors give an account of a new technique whereby stomata and hairs, etc , may be studied more conveniently and expeditiously. Briefly the method consists of coating the leaves with solutions of cellulose nitrate (collodion) or cellulose acetate. Films with impressions of the stomata are thereby formed, and can readily be removed from the leaves as they dry. They are then placed on microscope slides and kept flat by means of a

second thinner slide placed on the top of them, and retained in position by means of rubber bands until the films are hardened. No mounting medium is used. Counting the stomata is stated to be most easily carried out by means of a binocular microscope, " one eyepiece of which carried the usual micrometer scale for measuring sizes, and the other a counting chamber or square with an area of 1·093 sq. mm. divided into forty-nine smaller units. The count is recorded by means of a Veeder-Root hand tally, with a setback knob for quickly returning to zero." The method can also be applied for other purposes, such as examining other plant organs, various types of fossils, and the hard parts of animals. C. R. M.

Studies in the Development of Nepenthes.—R. Kuhl (" Vergleichend-entwicklungsgeschichtliche Untersuchungen an der Insectivore *Nepenthes*," *Beih. Bot Centralb.*, 1933, **51**, Abt. 1, 311–34, 22 figs) The first part of the investigation described in this paper is concerned with the development of the pollen and ovules of *Nepenthes* The question whether *Nepenthes* is closely related to *Sarracenia* is discussed, and the author concludes that in spite of the similarity in the development and structure of both types the problem must remain unsolved. In the second part of the paper an account is given of the histology of the leaves during their development to form pitchers. C. R. M.

Mode of Formation of Patterns on Pollen Grains.—R. P. Wodehouse (" An Oil-drop Theory of Pollen Grain Pattern Formation," *Amer. J. Bot.*, 1934, **21**, 18–22, 4 figs). The author believes that as pollen grains develop they absorb the aqueous phase of the oily emulsion by which they are surrounded, so that the oil is thrown out of suspension and consequently condenses in droplets on the surface of the grains. " These droplets, since they are separated from each other by a viscous aqueous solution, assume a least surface configuration, which, however, is somewhat modified and controlled in spatial orientation by such contours of the grains as may be due to their three or more pores and furrows. With oil-drops so arranged upon their surface, the deposition of the material of the outer layer upon the pollen grains can take place only between the oil droplets, consequently this material is built up on a pattern corresponding to the configuration of their interstices. ' C. R. M.

Accessory Pistils in Actæa spicata L.—Emilia M. Chiarugi (" Formazione di Pistilli Accessori in *Actæa spicata* L.," *Nuov. Giorn. Bot Ital* , 1933, **40**, 531–5, 1 pl.). The normal flower of *Actæa spicata* L. consists of calyx, corolla, numerous stamens and a single carpel. Various anomalies are described including the formation of accessory pistils by transformation of stamens, doubling of the pistil by synanthy and gymnospermy of the ovules through an imperfect suture. In all cases fertile seeds were produced. A. W. E.

Embryology of the Asclepiadaceæ.—Paola Pardi (" Contributo all Embriologia delle Ascelepiadaceæ," *Nuov. Giorn. Bot. Ital.*, 1933, **40**, 560–9, 23 figs.). The development of the female gametophyte was studied in the following eight species of Asclepiadaceæ: *Asclepias curassavica*, *Calotropis procera*, *Cynanchum Vincetoxicum*, *C. fuscatum*, *C. speciosum*, *Ceropegia Woodii*, *C. debilis*, and *Dictyanthus ceratopetala*. Of these only *Cynanchum fuscatum* follows the *Scilla* type of development, all the others belonging to the normal type. A. W. E.

Abnormal Flowers of Argemone mexicana L.—A. C. Joshi (" Some Abnormal Flowers of *Argemone mexicana* L.," *J. Ind. Bot. Soc.*, 1933, **12**, 255–71, 9 figs., 1 pl.). An account of some flowers of *Argemone mexicana* L. which differed

from the normal in having: (1) Sepals which did not fall off when the flowers opened. (2) Petals which were green, or intermediate between green and the normal yellow colour. (3) Stamens which were partly but never completely foliaceous. In some instances the filaments and connectives were much enlarged and provided with a reticulation of veins. Abnormal anthers were not observed to open, and the stamens did not wither even in old flowers. (4) In some instances a gynophore developed below the ovary. The ovules, which were less numerous and on longer stalks than is normal, did not mature. Microscopical examination of the leaf-like filaments of the abnormal flowers showed that the vascular strand formed a midrib, with branches extending into the well-developed mesophyll. Chloroplasts were abundant in the mesophyll, and stomata with slightly sunken guard cells were present on the upper and lower surfaces in the region of the wings. The anthers of abnormal stamens were provided with unusually large connectives, having stomata on both the dorsal and ventral surfaces. Besides the median bundle to be seen in the connectives of normal stamens, there were in abnormal ones two additional bundles situated near the pollen sacs. The pollen grains from abnormal stamens were one-quarter to one-third of the size of normal grains. The integuments of the ovules from abnormal flowers were entirely free from one another and from the nucellus. The apex of the nucellus was acutely elongated in the region of the micropyle. The embryo sac, in all the specimens examined, was found to have been reduced to a hollow cavity in the nucellus. The vascular bundle leading to the abnormal ovules was well developed, and, instead of terminating in the chalazal region, divided at this point into five or six small strands, "one situated at the centre and the others forming an irregular ring around it." The central strand supplied the base of the nucellus and the outer and inner integument. The author discusses the nature, cause, and phylogenetic significance of the abnormalities described. He believes that they afford evidence of the close relationship of the Papaveraceæ to the Capparidaceæ, and lend support to the theory of the pteridospermous origin of the angiosperms. C. R. M.

Flora Morphology in Musa errans.—José B. Juliano and Proceso E. Alcala ("Floral Morphology of *Musa errans* (Blanco) Teodoro var. *Botoan* Teodoro," *Philipp. Agric.*, 1933, **22**, 91–116, 1 fig., 5 pls.). The banana used was a seeded Philippine variety, *Musa errans* (Blanco) Teod. var. *Botoan* Teod. Fertile-seeded and sterile-seeded forms were studied. The spicate inflorescences of both types consist of female flowers below followed by a few neuter flowers, the terminal flowers being male. The development of the floral organs is acropetal and their order of appearance is as follows: outer perianth lobes, inner perianth lobes, stamens, and pistil. Usually, one of the stamens becomes aborted in the male flower. In the functional stamens the archesporium and tapetum arise by simple regional differentiation. Only the endothecium and the layer below it persist in the mature anther. Linear or tetrahedral forms of tetrads in pollen grain development were noted. Degeneration of pollen grains occurs, and many possess supernumerary tube-nuclei before dehiscence. The ovule is anatropous. The single hypodermal archesporial cell divides periclinally into an outer parietal cell and an inner megaspore mother-cell. Eventually, two or three layers of parietal tissue may be found between the megaspore mother-cell and the nucellar epidermis. Four megaspores arise, sometimes only three, the chalazal one becoming functional. The megagametophyte is normal, with the synergidæ and antipodals sometimes remaining after fertilization. A small embryo results from the zygote remaining dormant long after fertilization. The endosperm is nuclear and its development normal, and it is not absorbed entirely by the embryo at maturity.

A certain amount of the nucellar tissue remains as perisperm. In the sterile form the endosperm fails to store starch grains. Pollination was found to be necessary for proper development of the fruit. Seed development is described. The softness of the sterile seed is due to the fact that, although the outer integument develops normally, the contents may collapse and separate from the integument. F. B.

Morphology of the Seed of the Snowberry.—NORMA E. PFEIFFER ("Morphology of the Seed of *Symphoricarpus racemosus* and the Relation of Fungal Invasion of the Coat to Germination Capacity," *Contrib. Boyce Thompson Inst.*, 1934, **6**, 103–22, 6 figs.). The mature seed coat in *Symphoricarpus racemosus* is derived mainly from the innermost layers of the ovary wall with a little integumental tissue. The inner epidermis of the ovary wall gives rise to a narrow fibrous layer, the adjacent cells develop a layer containing calcium oxalate crystals, while the next few layers originate a wide fibrous layer in which the fibres are orientated at right angles to those in the first layer. A less modified single layer of cells covers the fibres. Integument tissue is represented by a thickened outer epidermis and some layers of crushed parenchyma cells. No nucellar cells remain. Two cuticle layers are present: one between the fibres and the integument epidermis and a thicker one between the crushed integument parenchyma and endosperm. Cellulose, pentosans, and lignin are present in the fibre walls and the integument epidermis. These substances, by fungal decomposition in moist media at favourable temperatures, cause the seed coats to disintegrate, thus removing a mechanical barrier to germination. Exposure to sulphuric acid for different periods of time reduces the amount of fibrous tissue in proportion to the length of exposure. Longer exposures favour development of fungi. Too long exposure is found to be disadvantageous. Both inner and outer cuticles of the seed coat seem to be barriers to fungal invasion. The embryo is small. F. B

CRYPTOGAMIA.

Pteridophyta

Noeggerathiæ and Tingiæ.—ISABEL BROWNE ("The Noeggerathiæ and Tingiæ: the Effects of their Recognition upon the Classification of the Pteridophyta: an Essay and a Review," *New Phyt.*, 1933, **32**, 344–58, 2 figs.). A discussion of the interrelationships of the Pteridophyta in view of what is now known of the morphology of the Noeggerathiæ and Tingiæ. The facts as we have them are perplexing. Němejc proposed a classification into seven groups—Psilophytales, Lycopodiales, Psilotales, Noeggerathiales, Articulatales, Cladoxylales, Filicales. Another scheme is suggested in the present paper—Psilophytales, Lycopsida, Sphenopsida, Pteropsida, where Sphenopsida would include Psilotales, Noeggerathiales, and Articulatales. A. G.

Selaginella in Mexico.—A. H. G. ALSTON ("Notes on *Selaginella*. IV. A Revision of Liebmann's Mexican *Selaginellæ*," *J. Bot.*, 1933, **71**, 239–43, 1 pl.). A brief account of the travels of Frederik Michael Liebmann in Mexico, 1841–3, and a revision of the twelve species of *Selaginella* which he collected, mostly in Vera Cruz, together with an analytical key, and several figures of *S. faucium* Liebm. A. G.

Pellæa.—W. N. STEIL ("The Archegonia of *Pellæa viridis* (Forsk.) Prantl," *Bull. Torrey Bot. Club*, 1934, **61**, 9–12, 5 figs.). In 1915 the development of archegonia on the normal prothallia of *Pellæa viridis* was described; these archegonia

behaved normally. Embryos of apogamous origin were also described; they occurred on the cushion behind the apical notch of the cordate prothallium. Further information is now given. When the prothallium was grown in subdued light a proliferation grew out, varying from ligulate to filiform, and on a plate-like expansion produced two archegonia in a small-celled meristematic region. This is figured, and an embryo of apogamous origin is shown in course of development. Filaments of short meristematic cells are commonly associated with apogamy in the gametophyte of other ferns. A. G.

Lithostegia.—R. C. CHING ("*Lithostegia*, a New Genus of Polypodiaceous Fern from Sikkim-Yunnan," *Sinensia*, 1933, **4**, 1–9, 1 pl.). *Aspidium fœniculaceum* Hook., an Indo-Chinese fern, is shown to differ so markedly from *Aspidium*, *Polystichum*, *Lastrea*, *Diacalpe*, to which it has been referred by various authors, as to require the creation of a new genus. The new generic name, *Lithostegia*, refers to the tough nature of the indusium. The outstanding generic characters are: (1) the short rhizome with eudryopteroid scales, (2) large deltoid frond very finely subdivided; (3) long fibrillose scales on the costa, costules, and veins; (4) soriferous segment situated as in *Davallia*; (5) indusium coriaceous, at first covering the whole of the terminal sorus like a scale, later split open along the upper interior side and pushed aside, but persistent; (6) spores bilateral, ovate, surrounded by a broad transparent wing. *Lithostegia* appears to be intermediate between *Diacalpe* and *Acrophorus*, being nearer to the latter than to the former. It has only one species. A. G.

Polypodium Dryopteris.—R. C CHING ("On the Nomenclature and Systematic Position of *Polypodium Dryopteris* L. and Related Species," *Contrib. Biolog. Lab. Sci. Soc. China*, 1933, **9**, 30–43, 1 pl.). The distinctive characters of *Polypodium Dryopteris* L. are pointed out: the structure of the rhizome; the shape and texture of the lamina with its basal articulation; the symmetrical branching of the lamina, the roundish exindusiate sori, dorsal on the veinlets; the bilateral warty spores without perisporium. The plant has been referred to *Polypodium*, *Polystichum*, *Nephrodium*, *Lastrea*, *Gymnocarpium*, *Phegopteris*, *Dryopteris*; and it might fall under *Currania* of Copeland. But owing to its morphological and structural peculiarities, it does not fit into any of the above large genera. The author therefore revives the name *Gymnocarpium* Newman (1851), revises its definition (including *Currania* of Copeland as a synonym), and enumerates the following species: *G. gracilipes* (Copel.), *G. oyamense* (Baker), *G. Dryopteris* (L.) Newm, *G. remotum* (Hayata), *G. Robertianum* (Hoffm.) Newm. The synonymy and distribution of these species are detailed, and a key to the species is provided. A. G.

Bryophyta.

Water Conduction of Mosses.—ESTHER J. BOWEN ("The Mechanism of Water Conduction in the Musci considered in Relation to Habitat. III. Mosses growing in Dry Environments," *Ann. Bot.*, 1933, **47**, 899–912, 23 figs.). Eight species of mosses from dry habitats were investigated: *Hypnum cupressiforme* var. *filiforme*, *Dicranum scoparium*, *Hylocomium triquetrum*, *Ditrichum flexicaule* var. *densum*, *Anomodon viticulosus*, *Polytrichum commune*, *Mnium hornum*, *M. undulatum*; and the sequence in which they are given corresponds to the order of the increasing drought of their habitats. The external morphology and habit of these plants was found to be correlated with their capacity to conduct water externally. The internal paths of water conduction were also investigated. In the first six

of the above mosses the amount of external conduction of water was found to exceed the internal, it travelled upwards in the form of capillary films between the stem and leaves and was absorbed by unthickened cells towards the apices of stem and branches, and diffused downward inside the plant. But in *Mnium* the internal conduction predominates, corresponding with the much greater differentiation of internal tissue in the stem and the presence of definite conducting hydroids in the leaves. A. G.

New Zealand Mosses.—H. N. Dixon and G. O. K. Sainsbury ("New and Rare Species of New Zealand Mosses," *J. Bot.*, 1933, **71**, 213–20, 244–51). An annotated list of fifty-three New Zealand mosses, including descriptions of twelve new species and two varieties. The list forms a supplement to Dixon's "Studies in the Bryology of New Zealand," published in Bulletin No. 3 of the New Zealand Institute. A. G.

Frullania.—W. E. Nicholson ("*Frullania Tamarisci* (L.) Dum. var. nov. *Schiffneri*," *J. Bot.*, 1934, **71**, 347–8). *Frullania germana* was recorded from Cornwall many years ago, but the record has not been verified; but a plant much resembling that species has been found on rocks near the sea around the Lizard peninsula. This plant proves to be a remarkable variety of *F. Tamarisci.* It is here described, and the characters by which it is distinguished from *F. germana* are pointed out. A. G.

Thallophyta.

Algæ.

Myxophyceæ of Nanking.—Chu Chia Wang ("A Brief Account of the Occurrence of the Myxophyceæ of Nanking," *Contrib. Biolog. Lab. Sci. Soc. China*, 1933, **9**, 8–17). The blue-green algæ of Nanking comprise thirty genera and more than seventy species. In the present account they are divided into three groups: (1) subaerial, and withstanding considerable desiccation (fifteen species); (2) inhabiting rocks perpetually wet with dripping or trickling water (twenty-one species); (3) aquatic, occurring in rain pools, ditches, ponds, streams, rivers, rock pools, hot springs (thirty-three species). The annual rainfall is about 40 inches, principally from April to September, during which period the blue-green algæ flourish best. During warm weather they become a nuisance by causing an unpleasant taste and smell in the water. A. G.

Myxophyceæ of Nanking.—Chu Chia Wang ("Three New Species of Myxophyceæ of Nanking," *Contrib. Biolog. Lab. Sci. Soc. China*, 1933, **9**, 92–6, 1 pl.). Descriptions and figures of two new species of *Arthrospira* and one of *Cylindrospermum* from wet places in the vicinity of Nanking. A. G.

Sphærotilus and Diatoms.—Einar Naumann ("Notizen zur Ökologie der Süsswasseralgen. IV. Über Algenaufwuchs bei *Sphærotilus natans* Kützing," *Arkiv för Botanik*, 1933, **25**, A, no. 9, 1–4, 1 pl.). A discussion of the part that *Sphærotilus natans* Kutzing plays: (1) as an indicator of water pollution; (2) as a purifier of polluted water of rivers. The plant itself is now classed among the filamentous bacteria; but it rarely occurs as a pure growth; its delicate bushy filaments capture and become more or less densely intermingled on the one hand with wood fibres, paper filaments, etc., brought down by factory effluents, and on the other hand with diatoms, mainly *Fragilaria capucina* and *F. crotonensis*; also *Tabellaria fenestrata* and a dozen others are cited. It is the colony of diatoms which is responsible for water purification. A. G.

Leptomitus and Diatoms.—EINAR NAUMANN ("Notizen zur Ökologie der Süsswasseralgen. V. Über Algenaufwuchs an *Leptomitus lacteus* (Roth) C. A. Agardh," *Arkiv för Botanik.*, 1934, **25**, A, no. 18, 1–4, 1 pl., 1 fig.). *Leptomitus* is a saprolegniaceous fungus which may, like *Sphærotilus*, contain entangled in its tufts a multitude of diatoms. Dr. Fr. Hustedt examined such a tuft and found in it seventy species and four varieties of diatoms. Such a colony of diatoms may well act as a water purifier. A. G.

Protosiphon.—A A. NAYAL ("A Desert *Protosiphon*, *Protosiphon botryoides* (Kutz) Klebs, var. *deserti*," *Ann Bot.*, 1933, **47**, 787–98, 17 figs.). An account of the occasional appearance of a new variety of *Protosiphon botryoides* after heavy autumn rain in the desert near Cairo. Its general morphology and life-history are described; it produces biciliate swarmers which are either zoospores or facultative gametes; the latter fuse end to end and produce thick-walled stellate zygospores, from which new plants arise. Zoospores germinate directly. Resting spores are formed at any time under adverse conditions and withstand drought; they readily germinate when wetted. By a series of experiments it was ascertained that the plant flourishes at temperatures between 7° and 50° C., but is less tolerant of higher temperatures. It shows normal growth in water containing up to 1 p c. of sodium chloride, but not exceeding this salinity A. G.

Chlorochytrium.—B T PALM ("On Parasitic and Epiphyllous Algæ. I A *Chlorochytrium* on *Polygonum*," *Revue Algologique*, 1933, **6**, 337–46, 8 figs) An account of a species of *Chlorochytrium* which produces minute red dots on the leaves of *Polygonum lapathifolium* in Sweden It is nearly allied to *Chl. Lemnanthemum* and *Chl rubrum*. The young alga is about 10μ in diameter, and has a definite cellulose membrane, a nucleus, and two or more small pyrenoids It enters the host plant through a stoma and grows until it fills the stomatal chamber, forming a minute gall Finally there remains a resting sporangium surrounded with protoplasm, nuclei, and plastids of the host plant. The alga undoubtedly has a pathogenic action on the host tissue A G

Epiphyllous Algæ. B T PALM ("On Parasitic and Epiphyllous Algæ. II. *Stomatochroon*, a Genus of Stomaticolous Chroolepideæ," *Arkiv for Botanik*, 1934, **25**, A, no 16, 1–16, 5 figs) A description of *Stomatochroon*, a new genus of tropical epiphyllous algæ, and of *St Lagerheimii*, a new species from Medan, Sumatra The morphology and life-history are discussed, and it is shown that species of *Stomatochroon* inhabit the stomata of a large number of host plants in the tropics A. G

Scenedesmus of Nanking.—SITZEN FANG ("On some Species of *Scenedesmus* of Nanking," *Contrib Biolog. Lab. Sci Soc China*, 1933, **9**, 97–107, 3 pls.). An account of nine species and three varieties of *Scenedesmus* collected in ditches and ponds in the neighbourhood of Nanking, with figures of their structure and a key to the species. *S obliquus*, *S. bijuga*, and *S. quadricauda* are common and abundant. A. G.

Draparnaldiopsis.—YAJNAVALKYA BHARADWAJA ("A New Species of *Draparnaldiopsis—D. indica* sp. nov," *New Phyt*, 1933, **32**, 165–74, 1 pl., 2 figs.). Description of a new species of alga from a shallow pond at Benares in India, with a detailed account of its morphology. Its affinities are discussed and the plant is referred to the American genus *Draparnaldiopsis*, the diagnostic characters of which are here slightly modified so as to admit the Indian species more fitly.

A. G

Codium Bursa.—MARCEL V. HOMÈS ("La Conservation de *Codium Bursa* en herbier ou en liquide," *Bull. Soc. Roy. Bot. Belg.*, 1933, **66**, fasc. 1, 34–6, 4 figs.). This spherical species of *Codium* loses its shape when dried in the press. The author recommends that the fresh plant should be frozen, then sliced into a series of sections 5–10 mm thick; these sections, after being dried, should be mounted in order in the herbarium, and then show perfectly the details of structure—the palisade layer, the felted stratum, the trabeculæ. Another method, useful for purposes of exhibition, is to inject agar-agar solution to fill the cavity, chill the specimen in order to set the jelly, and bottle it in a suitable preservation liquid; this method is also a good one when microscopic sections are required. A. G.

Gigartina.—WILLIAM ALBERT SETCHELL and NATHANIEL LYON GARDNER ("A Preliminary Survey of *Gigartina*, with Special Reference to its Pacific North American Species," *Univ. Calif. Pub. Bot.*, 1933, **17**, 255–340, 20 pls.) A historical account of the genus *Gigartina*. The number of species recognized is eighty-eight, and these are arranged in seven sub-genera—*Eogigartina*, *Mesogigartina*, *Eugigartina*, *Chondracanthus*, *Chelogigartina*, *Chondrodictyon*, *Mastocarpus*. The first four constitute the series Pinnatæ, the fifth and sixth form the series Magnifoliatæ, and the seventh the series Palmatæ. The greater part of the paper is concerned with a revision of the thirty species found on the Pacific Coast of North America, including descriptions of two new species. Among the plates are photographs of several of the type-specimens in the Agardh herbarium at Lund. A. G.

Algal Confusions.—WILLIAM ALBERT SETCHELL ("Some Early Algal Confusions. II," *Univ. Calif. Pub. Bot.*, 1933, **17**, 187–254, 20 pls.) Further notes on the identification of *Codium decorticatum* (Woodward) M. A. Howe and on the characters by which it is distinguished from *C. elongatum* Ag., *C. lineare* Ag., and *C. decumbens* Martius. This is followed by an endeavour to disentangle the confusion in which the various species of *Sargassum* from Hong Kong and the Central Pacific are involved, especially the group of species, varieties, forms, and states included in the sub-genus *Bactrophycus*. These were mostly described from fragmentary specimens, and a close investigation of them and of Turner's drawings in the light of plentiful new material from Hong Kong leads to the view that eight of the species must be regarded as forms or states of *Sargassum siliquastrum* (Turn.) Ag., and that five others are possible ecophenes, and one a possible mutant. Other species which are discussed are *S. enerve* Ag., *S. fulvellum* (Turn.) Ag., *S. heterophyllum* (Turn.) Ag., *S. acinarium* (L.) Ag., *S. Swartzii* (Turn.) Ag., *S. pallidum* (Turn.) Ag. A. G.

Seasonal Changes of Algæ.—CONSTANCE MACFARLANE and HUGH P. BELL ("Observations of the Seasonal Changes in the Marine Algæ in the Vicinity of Halifax, with particular reference to Winter Conditions," *Proc. Nova Scotian Inst. Sci. Halifax*, 1934, **18**, 134–76, 2 figs.) A report on studies of the algæ of Halifax during two winters, and on the succession of algal crops in the sea and in a lagoon; supplemented by the collection of algæ during spring, summer, and autumn for a period of seven years. The seasonal succession of crops showed a dominance of *Ilea*, *Scytosiphon*, *Dumontia*, *Polysiphonia* from autumn till the middle of January; then of *Monostroma*, *Spongomorpha*, *Bangia* until the end of April; and thereafter of *Laminaria*, *Chorda*, *Polysiphonia*, etc., gradually replaced by *Chordaria*, which becomes dominant by June. In late August and early September the annuals disappear and a comparatively barren period prevails. A list of eighty species is given with notes on the frequency, habitat, and season of each species. A. G.

Salt Marsh Algæ.—NELLIE CARTER ("A Comparative Study of the Alga Flora of Two Salt Marshes. Part III.," *J. Ecology,* 1933, **21**, 385–403, 3 figs.). In this concluding part of the ecological study of the algæ of the two salt marshes of Ynyslas and Canvey the following communities are described: Chlorophyceæ in general, diatoms of the marsh margin, Cyanophyceæ of the margin, *Ulothrix flacca*, *Enteromorpha minima* with *Rhizoclonium*, *Anabæna torulosa*, filamentous diatoms, autumn Cyanophyceæ, *Phormidium autumnale*, *Rivularia* with *Phæococcus*, *Pelvetia canaliculata* ecad *muscoides*, *Catenella Opuntia* with *Bostrychia scorpioides*. A. G.

Spanish Algæ.—PEDRO GONZÁLEZ GUERRERO ("Mezclas botánicas," *Bol. Soc. Española Hist Nat.*, 1933, **33**, 139–44, 2 figs.). An account of some freshwater algæ, some of which are new to the Spanish flora, with notes on their distribution, associations, and morphology. *Penium minutum* occurs mingled with *Vaucheria terrestris* in Fuente Piedra (Málaga), a large shallow brackish lake which dries up in the summer yielding large quantities of salt; other plant life, such as *Arthrocnemon* and *Juncus* is confined to the margin. *Enteromorpha* is absent from this lake, but occurs associated with diatoms in similar brackish water at Osuna (Sevilla). *Hydrodictyon reticulatum* flourishes in the Río Zújar, where it is associated with *Pediastrum*, *Tetraëdron*, *Cœlastrum*, *Gongrosira*; and *Glœotrichia natans* is epiphytic on *Ceratophyllum*. The forms of *Pleurococcus vulgaris* are discussed; the plant abounds on tree trunks which are not too strongly illuminated, and not too shaded (*Taxus*), and are not growing in town streets; but it does not occur on *Vitis vinifera*. A. G.

American Algæ.—G. M. SMITH ("The Freshwater Algæ of the United States," New York: McGraw-Hill, 1933, pp. xi + 716, 449 figs.). A classified account of the genera of freshwater algæ of the United States with a full treatment of their morphology and life-history, with figures and with keys to the families and genera; representative species are cited, and a large bibliography is supplied. A. G.

Chinese Algæ.—O. BORGE ("Schwedisch-chinesische wissenschaftliche Expedition nach den nordwestlichen Provinzen Chinas unter Leitung von Dr. Sven Hedin und Prof. Sü Ping-chang. Algen, gesammelt vom schwedischen Arzt der Expedition, Dr. David Hummel," *Arkiv for Bot.*, 1934, **25**, A; no. 17, 1–18, 2 pls.). The number of samples collected, mostly in Mongolia and Tien-shan, was eighty-three The classified list of determinations contains forty-one Myxophyceæ, one of the Chrysophyceæ, and sixty-one Chlorophyceæ, with several varieties. Five new species are described, and several species are figured. A. G.

Fungi.

Peronosporaceæ.—T. SAVULESCU and T. RAYSS ("Troisième contribution à la connaissance des Péronosporacées de Roumanie," *Ann. Myc.*, 1934, **32**, 36–51, 12 figs.). With this paper the number of recorded Peronosporaceæ found in Roumania has reached 162 species parasiting 248 plants. This paper deals with fifty-one, many merely listed with their localities, others described in detail and illustrated. Some new combinations and new species are made, notably *Peronospora Jaczewskii* on leaves of *Gypsophila muralis*, *P. Cerastii-brachypetali*, *P. Rosæ-gallicæ*, *P. Lathyri-hirsuti*, *P. Galii-rubioides*. F. L. S.

Helicocephalum.—C. Drechsler ("A New Species of *Helicocephalum*," *Mycologia*, 1934, **26**, 33–8, 1 pl.). This species is considerably smaller than the original and only other known species but otherwise resembles it closely. It was found on old maize-meal agar containing bacteria, nematodes, several fungi and amœbæ. The author considers that this genus, hitherto placed among the Hyphomycetes, may with "tolerable certainty" be placed in the Mucoraceæ. F. L. S.

Carpenteles.—C. L. Shear ("*Penicillium glaucum* of Brefeld (Carpenteles of Langeron) refound," *Mycologia*, 1934, **26**, 104–8, 3 figs.). Isolated from soil this fungus in culture agreed in conidial and perithecial characters with Brefeld's account and figures. Owing to much confusion in the nomenclature the new name *Carpenteles asperum* is adopted instead of *P. glaucum* (Link) Brefeld, the name proposed by Langeron for Brefells, so-calded *P. glaucum* Link. F. L. S.

Herpotricha.—E. Gaumann, C. Roth and J. Anliker ("Ueber die Biologie der *Herpotricha nigra* Hartig," *Zeitschr. f. pflanzenkrankh. u. pflanzensch.*, 1934, **44**, 7–117, 9 figs.). The paper deals with the question of the selective power of the fungus with regard to hosts as observed from infection experiments, the method of parasitization and the causes, chiefly humidity, which determine the peculiar distribution of the fungus in nature. F. L. S.

Dasyscyphæ.—G. G. Hahn and T. T. Ayers ("*Dasyscyphæ* on Conifers in North America. I. The Large-spored White Excipled Species," *Mycologia*, 1934, **26**, 73–101, 6 pls.). The European larch canker, *Dasyscypha Willkommii* (Hart.) Rehm, was found on imported *Larix europea* and *L. leptolepis* in Massachusetts. *D. calycina*, regarded as a saprophyte, is believed to have been introduced into America with the larch canker disease and was found on the above-named species of larch and on *Pseudotsuga taxifolia*. Artificial inoculation did not take on healthy trees, but only on a dying Douglas Fir. Other large-spored forms of *Dasyscypha* hitherto regarded as *D. Willkommii* or *calycina* the authors describe as the new species *D. occidentalis*, *D. oblongospora*. These forms do not cause canker on Larch or Douglas Fir. F. L. S.

Sclerotinia.—F. L. Drayton ("The Sexual Mechanism of *Sclerotinia Gladioli*," *Mycologia*, 1934, **26**, 46–73, 4 text-figs., 3 pls.). Apothecia were obtained as a result of brushing the small columnar light brown pilose structures growing on the stroma with the microconidia or spermatia. Monomycelial cultures produce both microconidia and the columnar receptive bodies, but these appear to be self-sterile. Apothecia result only by fusion of elements from different thalli. The phenomenon is not regarded as one of heterothallism, for there is no segregation of sexes in separate thalli, but the thalli are self-sterile and homothallic. Photographs illustrate the receptive structures showing their pilose receptive tips and the central ascogonial region and mature apothecia in culture. F. L. S.

Lamprospora.—J. Seaver ("Photographs and Descriptions of Cup Fungi. XX. A New *Lamprospora*," *Mycologia*, 1934, **26**, 162–4, 1 pl.). This fungus, which grew on *Sphagnum* in storage, has an apothecium with a convoluted lavender surface and is 3 cm. in diameter, an unusually large one for the genus. The spores are like those of *L. trachycarpa*. F. L. S.

Uromyces.—M. A. Rice ("The Relation of *Uromyces Caladii* and other Rusts to their Hosts," *Bull. Torrey Bot. Club*, 1934, **61**, 155–62, 3 pls.). The author disagrees with Dufrenoy's conclusion that the central vacuole of host-cells infected by fungus undergoes fragmentation into a number of small vacuoles, thereby

increasing contact surface and producing physico-chemical changes. She believes that the fungus neither penetrates nor plasmolyses the cytoplasm and by its invagination makes little alteration in the physical condition of the cytoplasm. F. L. S.

Jura Agarics.—P. Konrad and J. Favre (" Quelques champignons des Hauts-marais tourbeux du Jura," *Bull. Soc. Myc. France*, 1933, **49**, 181–204). An account of seven Russulas most commonly found in this region, and of four others the presence of which is thought to be accidental. F. L. S.

Pholiota.—A. Pilát (" *Pholiota fulvella* (Bull.) Bres. et *Pholiota confragosa* Fries in Cechoslovakia," *Hedwigia*, 1933, **73**, 247–52, 1 pl.). An account, with figures of spores and cystidia and photographs, of *P. fulvella* which is identical with the American *P. acericola* Peck, and of *P. confragosa*, a rare species found in cold parts of the Western Hemisphere. F. L. S.

Odontia.—L. W. Miller (" The Hydnaceæ of Iowa. II. The Genus *Odontia*," *Mycologia*, 1934, **26**, 13–33, 3 pls.). A monograph of the twenty species with camera-lucida drawings of spores, cystidia, basidia, clamp-connections, and hyphæ. *O. laxa*, distinguished from *O. fimbriata* and *O. ciliolata* by its floccose texture, large uniform hyphæ, and smaller spores, and *O. crustula* are described as new species while new combinations are made of *O. ciliolata* and *O. setigera*. F. L. S.

Corticium.—V. Litschauer (" Über zwei neue *Corticium*-Arten aus Tirol," *Ann. Myc.*, 1934, **32**, 52–7, 2 figs.). The fungi are *Corticium sulphureo-marginatum* occurring on dead wood of *Abies pectinata* and *A. excelsa*, and *C. asseriphilum* on rotten coniferous boards lying on damp earth. F. L. S.

Beauveria.—C. L. Lefebvre (" Penetration and Development of the Fungus, *Beauveria Bassiana*, in the tissues of the Corn-borer," *Ann. Bot.*, 1934, **48**, 442–53, 1 pl.). The infected larvæ, inoculated either by allowing them to crawl over a culture of the fungus or by injecting them with a spore suspension, turn pink and become comatose. In a moist chamber the mycelium envelops the larvæ in a white weft and sporulates. Manchurian larvæ, which it was hoped would provide insect parasites to control the corn-borer, were found to have been infected by *Beauveria Bassiana* in their original home, and on coming into conditions favouring renewed fungal growth they died. F. L. S.

Helminthosporium.—T. F. Yu (" Studies on *Helminthosporium* Leaf-spot on Maize," *Sinensia*, 1933, **3**, 273–319, 4 pls.). The disease is caused by *Helminthosporium Maydis* Nisikado and Miyake, its perfect stage being *Ophiobolus heterostrophus*. The blade especially and the sheath of the leaf and the bracts of the ear are attacked most readily, while the ears, midribs, and stem are susceptible if they have been wounded. The fungus, its development and physiology and cultural characters, inoculation experiments, and spore dissemination are described. As regards host range of thirty-five graminaceous plants inoculated *Zea Mays* alone was susceptible. F. L. S.

Stephanoma.—E. Miran Zinderen-Bakker (" *Stephanoma tetracoccum* spec. nov.," *Ann. Myc.*, 1934, **32**, 101–4, 1 fig.). This fungus was found on old fruit bodies of *Geoglossum glabrum*. It bears typical fulvous pollen-like chlamydospores with conspicuous spikes, having four smaller peripheral cells. F. L. S.

Apple-Spot.—F. M. Carter ("Investigation of Factors affecting Advance of Certain 'Apple-spot' Fungi within the Host Tissue," *Ann. Bot.*, 1934, **48**, 363–95, 19 figs.). It was found that the fungi spread very slowly when the concentration of malic acid was greater than 0·4 p.c. Changes in sugar concentration did not counteract the effect of the malic acid. The effect of nitrogen was also examined.

Mango Disease.—M. A. Palo ("A Sclerotium Seed-rot and Seedling Stem-rot of Mango," *Philipp. J. Sci.*, 1933, **52**, 237–62, 12 pls.). This hitherto undescribed disease of mango produces brown lesions, the leaves become pale and wilt, and white mycelium and sclerotia can be seen at the base of the stems in advanced stages of the disease. If infection is not severe the plant can recover. Severe rotting of the seeds in the beds also occurs. Cultural and morphological characters of the fungus were worked out, whence it is concluded that the mango sclerotium is a strain of *S. Delphinii.* Inoculation experiments proved its pathogenicity. F. L. S.

Wood Fungi.—Anna Walck-Czernecka ("Grzyby niszczace podklady kolejowe w polsie [sur les champignons destructeurs des traverses de chemins de fer en Pologne]," *Act. Soc. Bot. Pol.*, 1933, **10**, 179–291, 7 pls.). Of the twenty-six fungi found on railway sleepers the most dangerous are *Lentinus squamosus* on pine and *Dædalea quercina* on oak. Cultural and mycelial characters were studied to enable recognition of the species in the absence of fruits. Photographs and drawings illustrate the different types of mycelium and clamp connections.

F. L. S.

Soil Fungi.—H. Chaudhuri and G. S. Sachor ("A Study of the Fungus Flora of the Punjab Soils," *Ann. Myc.*, 1934, **32**, 90–101). An account of thirty-two fungi (chiefly Hyphomycetes and a few Phycomycetes) found on field, garden, alkaline, and humus soil. Five of these are described for the first time

F. L. S

Antagonism.—F. Gioelli ("Fenomeni di antagonisms tra *Penicillium digitatum* (Pers.) Sacc. e *Penicillium italicum* Weber," *Ann. di Botanica*, 1933, **20**, 327–46). The antagonism, at low temperatures, is usually manifested by a line of demarcation and by a neutral zone. The neutral zone is absent at high temperatures when there is much more vigorous growth and the line of demarcation is soon overgrown. When artificial medium is used, prepared with the juice and pulp of oranges and lemons, it was found that the using up of citric acid by one mould prevented growth of the other, but on the addition of citric acid the second was able to grow. Also toxic substances of one mould prevent growth of the other. F. L. S.

Spore Discharge.—B. Barnes ("Spore Discharge in *Basidiobolus ranarum* Eidam," *Ann. Bot.*, 1934, **48**, 453–8, 2 figs.). Barnes describes his experiments which showed that the conidia of *B. ranarum*, when grown on potato agar, are shot off from the conidiophores. He does not deny the validity of Nowak's experiments where the conidia were not so discharged, as the medium was of unknown composition and probably was not potato agar. F. L. S.

Arctic Micromycetes.—J. Lind ("Studies on the Geographical Distribution of Arctic Circumpolar Micromycetes," *Biolog. Meddel.*, 1934, **11**, 2, 152 pp.). The 422 fungi listed were found on the vascular plants in the herbarium of the Botanical Museum at Copenhagen and collected in Norway, Sweden, Finland, Russia, etc., in Eurasia and in Alaska, Labrador, Hudson Bay, etc., in America. In consequence

there is a preponderance of saprophytes and pyrenomycetes rather than of parasitic smuts, rusts, and mildews. The list is not exhaustive as species previously published are not recorded. There is no indigenous genus, the conclusion therefore reached is that the flora is a mixture of species of different ages and origins.
F. L. S.

Columbian Fungi.—R. A. TORO and C. E. CHARDON ("Über einige neue oder interessante Pilze des nord-östlichen Kolumbian," *Ann. Myc.*, 1934, **32**, 111–5). Six Microthyriales, three Perisporiales, three Dothideales are described as new in the seventeen fungi listed. F. L. S.

Congo Fungi.—M. BEELI ("Contribution à l'étude de la flore mycologique du Congo. Fungi Goossensiani. X," *Bull. Soc. Roy. Bot. Belg.*, 1933, **66**, 14–32, 3 pls.). Descriptions and keys are given of the Agarics recorded. Twenty-three of these are described and illustrated for the first time and belong to the genera *Schulzeria*, *Cortinella*, *Tricholoma*, *Clitocybe*, *Laccaria*, *Collybia*, and *Mycena*.
F. L. S.

Lepidodermopsis.—E. WILCZEK and CH. MEYLAN ("Note sur un nouveau champignon," *Bull. Soc. Vaud. Sci. Nat*, 1934, **58**, 179–81, 1 pl.). This specimen with greyish or whitish sporangia having crystals of a calcium salt, a black peridium, no capillitium and coffee-coloured gleba containing spherical hyaline spores may turn out to be a Myxomycete. F. L. S.

Lichens.

Japanese Lobariæ.—Y. ASAHINA ("*Lobaria*-arten aus Japan, III," *J. Jap. Bot*, 1933, 449–61, text-figs. 24–38. Japanese and German). The author continues his study of this interesting genus, evidently well represented in Japan. Four species are described of which two are new to science. Cryptocephalodia are described in *Lobaria japonica* A. Zahlbr., in *L. Zahlbruckneri* n.sp., in *L. nipponica* Asahina, and in var. *angustifolia*. The paper is fully illustrated. A. L. S.

Study of Lichen Nomenclature.—O. V. DARBISHIRE ("The *Lichen fucoides* of Various Authors and its Fate," *Brit. Mycol. Soc.*, 1934, 308–13, 3 pls.). The author has made a thorough study of the nomenclature of the species *Roccella fucoides*, *Lichen fucoides* de Neck (1771) and *L. fucoides* Latourette (1785) which are now synonyms of *Gyrophora* and *Cornicularia* species. In 1785 Dickson describes a *Lichen fucoides*, a true *Roccella*, but the author of this paper has decided that it is not sufficiently well defined, and prefers *Roccella phycopsis* Ach. (1786) with a more distinctive description. Much information is given as to the specimens of these lichens in the old herbaria, and also criticism and reproduction of the drawings made by the old-time collectors. A. L. S.

Arctic Lichens.—BERNT LYNGE ("Om utbredelsen av Endel Arktiske. Laver," *Svensk Bot. Tidsk.*, 1932, **26**, 401–30, 3 text-figs.). Lynge gives a comprehensive account of Arctic lichens: the regions examined include north-east Greenland and Northern Europe to Behring Straits. Instructive tables are given as to the occurrence of 102 species. One, *Parmelia grœnlandica* Lynge, is found in Greenland alone, the others are more widely distributed. A further set of tables gives the Arctic distribution of the genus *Rhizocarpon*. Six of these are circumpolar, others are found only in Greenland, Nova Zembla, or Behring Straits. A

survey of the characteristic forms of thallus, etc., is given, and the methods of distribution—by soredia, spores, etc.—are described under the title "diaspora."

A. L. S.

Notes on Lichens.—K. LINKOLA ("*Peltigera lepidophora* (Myl.) Vain. mit Apothecien gefunden *Ramalina angustissima* (Anzi) Vain. in Binnen-Finnland," *Mem. Soc. Faun et Flor. Fenn*, **7**, 1930–31, Helsingfors, 1932, 259–67). The author found specimens of *Peltigera lepidophora* well characterized by the presence of isidia, but on specimens of which no fructification had yet been found. On one plant he found a "leaflet" sparsely isidiose but with an incompletely developed apothecium. An examination of herbarium material also revealed the presence of similar immature apothecia. Attention has also been given to the habitats of *Ramalina angustissima*, a maritime species, which has been found on the shores of inland lakes. These inland habitats are described after search through different herbaria. It is noted that Crombie found specimens on inland mountains as well as on the sea-coast. Notes are also given on *Squamaria cartilaginea*, a maritime lichen, also recorded on inland lakes in Finland.

A. L. S.

Lichenicolous Parasite.—R. DUGHI ("Un nouveau Pyrénomycète lichenicole, *Adelococcus nephromiocolus* nov. sp.," *Bull. Soc. Bot. France*, 1933, **80**, 570-4). Dughi describes this new Pyrenomycete and the effect produced on the lichen thallus by the parasite. The lichen, *Nephromium lusitanicum*, grew abundantly on trees in the forest of Saint-Baume (Var). The thallus of several specimens was beset with slight protuberances, though the general morphology was not affected. The parasite was lodged in the medulla near to the gonidial zone and grew upwards towards the cortex, the upper part of the fungus alone appearing in the open A full account of the fungus is given, and comparison is made with other parasites on *Nephromium*.

A. L S.

Lichenological Notes, VII.—W. WATSON (*J. Bot.*, **71**, 1933, 314–18, 327–38). These two papers include records of many lichens from widely separated localities in the British Isles, many of them rare species or forms. D. A. Jones and H. H. Knight have supplied many specimens. A number of species new to the British flora are recorded and there are interesting notes on new localities and unusual habitats. Thus *Usnea articulata*, usually found on trees, was collected on stones in heathy ground; *Placodium decipiens*, a saxicolous species, grew on pales at Penarth. Several new varieties and one new species, *Thrombium cretaceum*, are described, the latter found on chalk stones in beech woods near East Dean. The paper is a valuable contribution to the British lichen-flora.

A. L S.

Influence of the Soil on Lichen Distribution.—FRITZ MATTICK ("Bodenreaktion und Flechtenverbreitung," *Beih. Bot. Centralb.*, 1932, **49**, 241-71, 3 pls). Mattick has divided his subject into several series. He has studied first of all soil reaction as regards general plant-growth, and he cites the work done on the chemical conditions of the soil, as also the various methods of determining the chemical content—the acidity and alkalinity. He then gives an account of the effect of the different conditions on the growth of flowering and spore-bearing plants, though much less is known of the influences affecting the growth of the latter—the algæ and fungi and finally the lichens. As regards lichens, though they have no root systems yet the crustaceous forms especially are closely associated with the habitat—soil, rock, bark, etc. The larger lichens also, as he points out, attract and absorb soil particles on their surface, proof of that being found in the ash of these plants; so that it has been possible to classify the lichens with

regard to the type of soil on which they grow. Examples are cited of the soil reactions, and Mattick describes the methods used in the research. In Part II are first studied the habitat and locality of lime rocks or lime soils on the rocks of different districts, on stony lake and sea-shores or other water conditions, as also the lime soils of woods, etc. He gives also a study of silica habitats with their more acid reactions, again enumerating the more frequent lichens to be found on such habitats. Heaths and turf moors of acid nature are also included in the survey. In Part III Mattick gives a division of lichens into six groups according to the reaction—acid or alkaline—of the different families and species, and there follows a systematic enumeration of the various families and genera studied. He finds that, on rocks, acid lichens are the more abundant. He divides all lichens according to these reactions into azidophil–neutrophil–basiphil and euryon–stenion–euryon, indicating a somewhat wide limit of acidity, while stenion includes those of narrow limit; lists of all these are given. A list of literature on this subject is added. A. L. S.

Life and Works of Vainio.—K. Linkola ("Edvard August Vainio, 1853–1929," *Acta Soc. pro Faun. et Fl Fenn.*, 1934, **57**, n. 3, 1–26, 1 pl.). Linkola has given an account of the life and work of the distinguished Finnish lichenologist E. Vainio. From his earliest years he studied plant life, finally under the influence of Norrlin. He began his study of lichens in 1873, and to these plants he mainly devoted his energies. His first paper including lichens was published in 1876 and thereafter his works dealt largely with these plants The most important and best known are the "Monographia Cladoniarum universalis" in three parts—I, 1887; II, 1894; III, 1897, and his "Étude sur la classification naturelle et la morphologie des Lichens du Brésil," I, II (1890). In 1901 he contributed the account of the lichens to the "Catalogue of African Plants collected by F. Welwitsch" (vol. II, part II), published by the Trustees of the British Museum. He published works on lichens sent to him by collectors all over the world and was engaged on a great work, "Lichenographia Fennica," incomplete at his death. A. L. S.

Mycetozoa.

Mycetozoa of the Jura.—C. Meylan ("Recherches sur les Myxomycètes du Jura, 1930–31–32," *Bull. Soc. Vaud. Sci. Nat.*, 1933, **58**, 81–91, 2 figs.). As a result of dry winter months a large number of species normally occurring in the summer are entirely absent. Among such are *Physarum citrinum*, *P. rubiginosum* and *Leptoderma iridescens*. Even the very commonest species make only a modest show after a dry winter. The species found are listed with notes, where necessary, and localities. *Diachea cerifera* G. Lister is transferred to the genus *Diacheopsis*. *Calloderma robustum* is described for the first time, and another specimen belonging to *Calloderma* is described but not named. F. L. S.

Plasmodial Cytoplasm.—A. R. Moore ("On the Cytoplasmic Framework of the Plasmodium, *Physarum polycephalum*," *Sci. Rep. Tôhoka Imp. Univ.*, 1933, **8**, 189–93). Experiments of passing the plasmodium through filters having very fine pores and of cutting out pieces of plasmodium with minute capillary tubes were made to determine the minimum size of viable pieces of plasmodium. The author concludes that the plasmodium contains long threads of living matter, the length of which must be at least $2{,}000 \times 5 \times 10^{-5}$, where 5×10^{-5} is the thickness. F. L. S.

TECHNICAL MICROSCOPY.

Microscopical Structure of a Series of Lizard Skins.—M. E. Robertson, *J. Int. Soc. Leather Trades Chem.*, 1934, **18**, 9–19. A description (with photomicrographs) of skins from lizards of the families *Varanidæ*, *Iguanidæ*, *Tejidæ*, and *Agamidæ*. The characteristic hard-wearing qualities of leather prepared from these skins are attributed to the absence of any grain layer, common to most other leathers, and to their peculiar fibre structure. A. H.

A Microscopical Study of Hair. II. The Effect of Tannery Beamhouse Treatment.—F. O'Flaherty and W. T. Roddy, *J Amer. Leather Chem. Assoc.*, 1934, **29**, 53–66. A study has been made of the effect of various depilatory materials on the structure of the hair. No alteration is apparent as the result of long soaking in water or salt solutions. Weak acid solutions are without effect, but comparatively strong solutions induce softening and a tendency to curl. Lime-water with an excess cause a contraction of the hair bulb, a point with practical significance. The presence of a little sulphide in the lime suspension causes swelling and ultimate digestion of cuticle and cortex. The amines are without such drastic effect. A. H.

Studies on the Physiology of Moulds. IV. Moulds on Chrome-tanned Skins.—I. H. Blank, *J. Amer. Leather Chem. Assoc.*, 1933, **28**, 583. To overcome mould growths on wet chrome leather when the latter is kept for any length of time during hot weather, treatment with a disinfectant solution is suggested. From tests made on chrome leather inoculated with *Aspergillus niger*, it is shown that *p*-nitrophenol is very effective for the purpose. Incidentally, cultural tests on *A. niger* in modified Czapek's broth containing various antiseptics gave results which were at variance with those obtained from tests on chrome leather. In treating the leather, the relative quantity of water present is a factor, and provided the water/leather ratio does not exceed 2 : 1, drumming in 1 part of *p*-nitrophenol per 5000 parts wet leather will prove a safeguard against mould growth for about a month. The chemical penetrates well, and is satisfactorily retained on washing the leather. A. H.

Critical Microscopy.—H. C. Waterman ("Notes on Belling's Green-light Method for Critical Microscopy," *Stain Technol.*, 1934, **9**, 21–2). The densest green-light filter mentioned in Belling's book "The Use of the Microscope," New York, 1930, is the Wratten filter No. 61. With a sufficiently powerful light source Wratten filter No. 62 gives ample illumination. With achromatic objectives and and aplanatic condenser, filter No. 62 gives much sharper images than does No. 61. A still sharper image is given by the combined filters, No. 45 and No. 15. Spectrophotometric absorption curves show that for this combination the limit wave-lengths transmitted are from 510 to 540 mμ with a maximum transmission at about 530 mμ. The combination Wratten No. 61 plus No. 45 also gives excellent results. A 150-watt lamp, silvered on the back half of its more nearly spherical part, gives sufficient light for the above filters. G. M. F.

Observations on Mould Growths on Pickled Sheepskins.—L. S. Stuart and W. R. Frey (*J. Amer. Leather Chem. Assoc.*, 1934, **29**, 113–8). *Penicillium* and *Alternaria* grow in a 5 p.c. gelatin–1 p.c. dextrose salt and sulphuric acid media if the *p*H is 2·4 or over. At *p*H 1·8 or below growth is inhibited except in the case of *Penicillium* when the salt concentration is low (4 p.c.) and the *p*H 1·8.

Mould growth during transit on sheepskins pickled in H_2SO_4 and NaCl is due probably to a decrease in the acidity below its effective inhibiting concentration. This is brought about by absorption of acid by the wood cask, while both moulds are capable of lowering the acidity of gelatin-peptone broth made acid with H_2SO_4 to *p*H 1·8. Suggested precautions against this form of damage are: (1) Prior soaking of casks in pickle liquor; (2) slight increase in acidity of the initial pickle; and (3) addition of 0·025 p.c. of *p*-nitrophenol to the pickle liquor. A. H.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C 1, ON WEDNESDAY, APRIL 18TH, 1934, AT 5.30 P.M. PROF. W. A. F. BALFOUR-BROWNE, M.A., PRESIDENT, IN THE CHAIR.

The President called upon the Secretary to submit a **Recommendation from Council** for the consideration of the Fellows.

The Secretary reviewed correspondence with Harvard University asking for information about a microscope which was donated to the College by Hollis in 1732 and was subsequently destroyed by fire in 1767 together with the entire College Library and philosophical instruments.

The microscope was of the Wilson screw-barrel type, and Council had considered the matter and unanimously recommended that an instrument of this type be presented to Harvard University in replacement of the one referred to which was the first microscope possessed by the College.

On the motion of Mr M. T. Denne, *O B.E* , seconded by Mr. A. W. Sheppard, it was resolved :—

> That the recommendation of Council to present to Harvard University a Wilson screw-barrel microscope and accessories from the Society's collection in replacement of that destroyed by fire in 1767, be approved and adopted.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows —The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Major Gerald Burrard, *D.S.O.*	Hungerford.
Herbert Holmes	London.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

As Honorary Fellow :—

Prof. Ernst Küster.	Giessen University.

As Ordinary Fellows :—

Ralph Gordon Harry.	Cardiff.
E. J. B. Verleyen.	Antwerp.

Donations were reported from :—

Messrs. Longmans, Green & Co.—

"The Atom." By John Tutin.

Mr. F. W. Mills, F.L.S., F.R.M.S.—

"An Index to the Genera and Species of the Diatomaceæ and their Synonyms." Part XI Ga—He By F. W. Mills.

Rev. Dingley P. Fuge, F.R.M.S.—

23 Species Slides of Naviculoid Diatoms.

Mr. John A. Long, F.R.M.S.—

48 Species Slides of Diatoms.

Dr. A. S. Burgess, F.R.M.S.—

A Zeiss Mechanical Stage

Votes of thanks were accorded to the donors.

Papers.—The following communications were then read and discussed :—

Mr. F. Haynes, M.A —

"Simplified Weigart-Pal and Bielschowsky Staining Technique for Class Purposes."

Mr. B. K. Johnson, D I C , F.R M S —

"Ultra-Violet Microscopy as applied to the Examination of Opaque Objects."

Votes of thanks were accorded to the authors of the foregoing communications.

The following paper was read in title .—

Prof. T. K. Koshy, F.R.M.S —

"Chromosome Studies in Allium II. The Meiotic Chromosomes."

Announcement.—The Secretary made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, May 2nd, 1934.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, MAY 16TH, 1934, AT 5.30 P.M., PROF. W. A. F. BALFOUR-BROWNE, M.A., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected :—

As Honorary Fellow of the Society :—

Prof. Ernst Küster.	Giessen University.

As Ordinary Fellows :—

Ralph Gordon Harry.	Cardiff.
E. J. B. Verleyen.	Antwerp.

Donations were reported from :—

Mr. F. W. Mills, F.L.S., F.R.M.S.—

"Index to the Genera and Species of the Diatomaceæ and their Synonyms." Part XII. By F. W Mills.

Akademische Verlagsgesellschaft M B.H.—

"Mikroskopische Technik." By Heinz Graupner.

Mr. John A. Long, F.R.M.S.—

48 Species Slides of Diatoms.

Votes of thanks were accorded to the donors.

Balance Sheet.—The President then called upon the Treasurer, Mr. C. F. Hill, to present his Financial Report and Balance Sheet for the year ended December 31st, 1933.

FINANCIAL REPORT FOR THE YEAR ENDED DECEMBER 31ST, 1933.

It is gratifying to report that as a result of the rigorous economies in expenditure effected during the past year the accumulated debit balance brought forward from the previous year has been considerably reduced and now stands at £73 1*s*. 6*d*. I am glad, too, to announce an increase in the number of Fellows on the Roll which is reflected in a slightly increased revenue from subscriptions.

It will be observed that the appreciable recovery in Trustee Funds is reflected in the Society's investments which stand in the books at £2273, while the market value of these at the close of the present accounting period was approximately £3000. Nevertheless, the income derived from this source has diminished by more than £10 per annum.

In view of the embarrassments incidental to the prolonged depression the Balance Sheet is satisfactory, but it should be noted that while the diminished revenue, which was rendered acute by the National crisis, has been met by the rigid economies I have referred to and carried the Society successfully through a most difficult period, it is doubtful if these can be continued indefinitely without seriously affecting the efficient conduct and discharge of the Society's important engagements particularly in regard to the work of the Committees, the upkeep of the Library, the maintenance of the Instrument and Slide collections, establishment charges, and the publication of the Journal. The printing and illustrating of the latter is a heavy burden upon the Society's income which, but for the valued assistance of the Royal Society most gratefully acknowledged, would have shown a heavier adverse balance.

An increase in the Society's revenue is urgently needed to enable it to discharge without anxiety these responsible obligations, and to this end I cordially invite the co-operation of the Fellows especially in regard to the exercise of their best endeavours to maintain the strength of the Fellowship by nominating suitable candidates for admission thereto.

I have pleasure in expressing my thanks to the Secretary, and to the Society's Honorary Auditors, Messrs. Thomson McLintock & Co., for their services during the year.

Dr. INCOME AND EXPENDITURE ACCOUNT

1932. £	s.	d.	Expenditure.	£	s.	d.	£	s.	d.
			To Balance, being Excess of Expenditure over						
356	19	0	Income at 1st January, 1933				235	9	7
			,, Rent, Lighting, Heating, Telephone and						
166	11	9	Insurance				174	6	6
354	0	0	,, Salaries, Reporting, etc.				356	10	0
			,, Sundry Expenses—						
			Library Books and Binding	14	16	8			
			Stationery, Printing, Postages and Sundry Expenses	69	0	6			
			Repairs and Renewals	5	16	5			
			Refreshments at Meetings	8	7	6			
106	4	1					98	1	1
			,, Journal—						
			Expenditure—						
			Printing	533	16	10			
			Editing and Abstracting	209	12	5			
			Illustrating	72	2	9			
			Postages and Addressing	26	7	1			
				841	19	1			
			Less Receipts— £ s. d.						
			Grant from Royal Society 100 0 0						
			Sales 479 5 3						
			Advertisements 72 9 2						
				651	14	5			
236	12	7					190	4	8
30	2	9	,, Depreciation on Furniture				28	13	6
£1250	10	2					£1083	5	4

Dr. BALANCE SHEET AS AT

Liabilities.	£	s.	d.	£	s.	d.
I. *Capital*—						
Being (*a*) Life Compounded Subscriptions received from 1st January, 1877, to 31st December, 1933	2065	12	6			
(*b*) Quekett Memorial Fund	100	0	0			
(*c*) Mortimer Bequest	45	0	0			
(*d*) A. N. Disney Bequest	100	0	0			
(*e*) Amounts received in respect of Sales of Books from the Library (surplus to the Society's requirements)	253	12	0			
£ s. d.						
(*f*) Admission Fees for 1931 and 1932 115 10 0						
Add : Received during 1933 46 4 0						
	161	14	0			
				2725	18	6
II. *Loan*				200	0	0
Note.—The Hon. Treasurer of the Society has advanced this sum to meet the cost of Publishing "The Microscope and Catalogue of Instruments." The Loan is made to the Society free of interest.						
III. *Sundry Creditors*—						
Subscriptions paid in advance	27	5	6			
Journal Subscriptions paid in advance	61	2	0			
On Account of Journal Printing, etc.	235	1	10			
				323	9	4
				£3249	7	10

London, 11*th May*, 1934. We have examined the Books and Accounts of the Royal Microscopical Society for the year to 31st December, 1933, and have found the transactions correctly recorded and sufficiently vouched.

In our opinion the foregoing Balance Sheet is properly drawn up so as to exhibit

Cyril F. Hill, *Hon. Treasurer.*

FOR YEAR TO 31st DECEMBER, 1933. Cr.

1932. £	s.	d.	Income.	£	s.	d.	£	s.	d.
			By Subscriptions	825	7	8			
			,, Subscriptions for 1933 unpaid . . .	35	0	6			
854	11	10					860	8	2
45	16	6	,, Donations and Sundry Receipts . . .				45	8	9
114	12	3	,, Interest on Investments and Deposit Account				104	6	11
235	9	7	,, Balance, being Excess of Expenditure over Income at 31st December, 1933 . .				73	1	6
£1250	10	2					£1083	5	4

31st DECEMBER, 1933. Cr.

Assets.	£	s.	d.	£	s.	d.
I. *Furniture and Equipment*—						
As at 31st December, 1932	271	4	9			
Additions during year	15	10	0			
	286	14	9			
Less : Depreciation at 10%	28	13	6			
				258	1	3
II. *Investments at Cost*				2273	18	2
£400 London & North Eastern Railway Co. 3% Debenture Stock.						
£500 Nottingham Corporation 3% Irredeemable Debenture Stock.						
£915 11*s*. 4*d*. India 3% Stock.						
£150 Metropolitan Water Board " B " Stock						
£612 London Midland & Scottish Railway Co. 4% Preference Stock.						
£200 New South Wales 5¼% Loan, 1947–57.						
£421 1*s*. 0*d*. 3½% Registered War Stock.						
£200 5% Conversion Loan, 1944–64.						
£100 3% Conversion Loan, 1948–53.						
Note.—The Market Valuation of the above investments at 31st December, 1933, was £2972 6*s*. 0*d*.						
III. " *The Microscope and Catalogue of Instruments* "—						
Amount expended on publication to date, less sales in previous years	187	15	4			
Less Sales for 1933	7	4	0			
Note.—The Hon. Treasurer of the Society has given his personal guarantee to meet any part of this expenditure that is not recovered by means of Sales of the Publication.				180	11	4
IV. *Sundry Debtors*—						
Subscriptions unpaid and amounts due in respect of Journal Sales, Advertisements, etc.				133	17	8
V. *Cash at Bank and in Hand*—						
At Bank on Deposit Account	250	0	0			
At Bank on Current Account	79	10	7			
In Hand		7	4			
				329	17	11
VI. *Income and Expenditure Account*—						
Balance, being excess of Expenditure over Income as per Account attached				73	1	6
				£3249	7	10

a true and correct view of the state of the Society's affairs, subject to it being noted that no account has been taken of the value of the Society's Library, Stock of Journals and Collection of Instruments (valued for insurance, together with the Furniture and Equipment at £7000).

(Signed) THOMSON McLINTOCK & CO.,

Chartered Accountants, Hon. Auditors.

71, *Queen Street, E.C.4.*

The number of Fellows on the Roll of the Society at December 31st, 1933, is as follows :—

Number of Fellows on the Roll at December 31st, 1932			490
Add :	Fellows elected during the year	27	
	Fellows reinstated during the year	2	29
			519
Less :	Fellows resigned (11) or removed (8)	19	
	Fellows deceased	7	26
			493

The total is made up of :—

(*a*) Ordinary Fellows	451	
of whom 415 have paid current year's subscription 21 are one year in arrear and 15 are two years in arrear 451		
(*b*) Compounded Fellows	26	
(*c*) Honorary Fellows	16	
		493

On the motion of Mr. C F. Hill, seconded by Mr. A. W. Sheppard, the Report and Accounts were approved and adopted.

Dr. L. P. Clarke moved, seconded by Mr S. C Akehurst, the following resolution which was carried unanimously :—

> "That the best thanks of the Society be conveyed to Messrs. Thomson McLintock & Co for their valued services as Honorary Auditors during the past year which the Fellows gratefully acknowledge "

On the motion of Prof Hewlett, the Fellows expressed with acclamation their thanks to the Treasurer for his kindness in continuing his loan to the Society, appearing in the Balance Sheet, free of interest.

Papers.—The following communications were then read and discussed :—

Dr. E. S. Horning, M A., D.Sc., F.R M.S.—

" Micro-incineration."

Prof. C. Leonard Huskins, Ph.D.—

" Recent Work on Chromosome Studies and Crossing-over."

Votes of thanks were accorded to the authors of the foregoing communications.

The following PAPERS were read in title :—

Joyce C. Hill, M.Sc.—

"Notes on 'in vitro' Culture of Pulmonate Molluscs."

Miriam Scott Lucas—

"Ciliates from Bermuda Sea Urchins. I. Metopus"

Announcements.—The Secretary made the following announcements :—

The next Ordinary Meeting of the Society will be held on Wednesday, October 17th, 1934

The next Meeting of the Biological Section will be held on Wednesday, November 7th, 1934.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 18th to September 15th, 1934.

The Proceedings then terminated.

NOTICES OF NEW BOOKS.

The Atom.—By JOHN TUTIN: with an Introduction by Prof F SODDY 1934. 103 pp Published by Messrs. Longmans, Green & Co, Ltd, 39, Paternoster Row, London, E C 4 Price 6s net.

Index to the Genera and Species of the Diatomaceæ and their Synonyms, 1816–1932: By F W MILLS Part XI Ga—He. April, 1934 Part XII He—Me May, 1934. Part XIII Me—Na June, 1934 Published by Messrs Wheldon & Wesley, Ltd, 2, 3, and 4, Arthur Street, New Oxford Street, London, W C.2 Price 10s per part

Mikroskopische Technik.—By HEINZ GRAUPNER. 1934 vii+157 pp 31 figs., 6 Tables Published by the Akademische Verlagsgesellschaft M B H, Leipzig. Price RM 5 20.

Arachnoidiscus.—An account of the genus, comprising its history, distribution, development and growth of the frustule, structure, and its examination and purpose in life, and a key to and descriptions of all known species, illustrated By N E BROWN, D.Sc, A.L S 1933 88 pp 7 plates Published by W Watson & Sons, Ltd, 313, High Holborn, London, W C 1 Price 6s net

Fishery Investigations. Series II Vol XIII No 1 Report on the North Sea Cod By MICHAEL GRAHAM 1933 160 pp 33 text-figs., 52 Tables Published by H M. Stationery Office, Adastral House, Kingsway, London, W.C 2 Price 7s. net.

Mikroskopische Technik: Taschenbuch der biologischen Untersuchungsmethoden I.—By HEINZ GRAUPNER. vii + 157 pp Published by Akademische Verlagsgesellschaft M B.H., Leipzig

This small paper-covered volume contains a short but useful account of all the more generally used techniques, the descriptions being on conventional lines. A list is given of German firms supplying optical apparatus, microtomes, dyes, and laboratory apparatus. An unusual feature is the text of the new German law of November 24th, 1933, dealing with experiments on animals. G. M F

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

SEPTEMBER, 1934.

TRANSACTIONS OF THE SOCIETY.

XI.—NOTES ON "IN VITRO" CULTURE OF PULMONATE MOLLUSCS. **591.81.**

By JOYCE C. HILL, M.Sc.

(Trinity College, Dublin.)

(*Communicated by Prof. J. Bronte Gatenby.*)

(*May 16th,* 1934.)

1. NON-ASEPTIC METHODS.

DURING some investigations on the ovo-testis of *Helix aspersa* Gatenby noted the presence of groups of amœboid elements which lived in drops of blood for several days. These cells came together to form masses, which appeared to increase in number and certainly kept alive and active for three days to a week at room temperature. This first attempt at obtaining cell outgrowths from *Helix* was described by Gatenby in a letter to *Nature*, December, 1931, and subsequent observations were described in two papers published in 1932 (Gatenby) and 1933 (Gatenby and Duthie).

This preliminary work on the gonad was extended to a study of other organs in the snail; a series of preparations were made from pieces of foot, visceral hump and roof of mantle cavity in drops of blood, in hanging drop preparations vaselined in hollow-ground slides. The roof of the mantle cavity was found to give the best results. Owing to the fact that the mantle cavity always seemed to be contaminated by bacteria, it was considered useless to take aseptic precautions in making the preparations; yet all the explants grew, even in the presence of active bacteria.

A drop of blood was placed on a slide, and in this a piece of the mantle cavity wall from the snail was cut up into ½ mm. squares, using a fine, sharp scalpel. Next, one of these small pieces was placed in the centre of a clean, square coverslip, covered with a drop of blood, and the coverslip inverted over a clean, hollow-ground slide which had been previously vaselined. The preparations were then placed in an incubator at 25°–30° C.

It was found that after a few hours amœboid elements began to migrate from the explant and eventually wander far out, being followed by sheets of epithelial cells. Another very interesting phenomenon observed by Gatenby was the appearance all round the explant of bladder-like outgrowths which moved slowly, with a pulsating peristaltic action. He noted the presence of long fibres and several types of cells stretching into these outgrowths.

A slight modification of the original type of preparation was also used, since it was thought that if some way could be found for providing a confined space the cells of the explant might grow better. Small pieces of coverslip were cut, and after a hanging drop preparation had been made as described, the extra cover was added underneath, so that the explant lay between two covers and was in consequence more compressed. As a result of this double coverslip method luxuriant outgrowths of shell epithelium and other cells were obtained.

Gatenby's best results were obtained with snail blood as the medium, though attempts were made to use instead mixtures of blood, albumen gland, and ovo-testis and Ringer. Ovo-testis was strained through cotton wool or silk, to get rid of the spermatic cells, and the drop then mixed with blood. In the same way crushed albumen gland was mixed with blood and strained. Such mixtures, however, he considered not so good as pure blood. His attempts at growing explants in Ringer or blood diluted with Ringer were also unsuccessful. Gatenby kept pieces of foot moving for as long as a week in hanging drops of blood, and found that they can be kept longer if the blood is changed, the explant being washed with blood before being transferred to the new coverslip. Dr. E. S. Duthie got similar results using heart explants.

In all these experiments no serious attempt was made to work under strictly aseptic conditions, since the pulmonary cavity always seemed to be contaminated with bacteria. Hence, the explant being already infected, Gatenby considered it useless to take aseptic precautions in his work. Yet explants from the mantle cavity roof always showed some form of outgrowth, and remained alive for at least a week. This point is very important, for among vertebrates no such growth is possible without observing rigid precautions against bacterial infection. This entails strict adherence to aseptic methods, with an elaborate technique. Nevertheless, the situation is less complex than among invertebrates, for explants can be obtained from vertebrates more easily in a sterile condition, and it is only necessary to prevent external contamination; in such invertebrates as the snail the explants from many parts of the body are often a source of infection, and must first be

sterilized before adopting the conventional aseptic technique. Gatenby, however, has shown that the sterility of explants of *Helix* mantle cavity wall is not essential for outgrowth, and that all the operations can be carried on without any regard for aseptic methods; such phenomena as migration of epithelial cells, outgrowth of amœbocytes, multiplication of groups of cells and cell movement are all successfully shown in these simple preparations. The cells survived and grew out despite the bacteria, and it was only when the latter became so numerous as to cloud the blood that outgrowth ceased. Even then the cells lived for days in such clouded media. In the ordinary hanging drop preparations kept at 26°–30° C. Gatenby found that the explant continued to undergo changes for at least three days In nearly every case bacterial infection then became very marked, so that changes in the cells of the explant ceased, and, finally, a stage was reached when a balance between the resistance of the tissue and the toxic effects of the bacteria was brought about. Nevertheless, these preparations lasted a long time; in one case Gatenby observed the presence of many living cells two months after the preparation was made.

Continuing the non-aseptic technique, the present writer tried the effects of using media other than blood. It was found that on substituting Ringer for blood in the double coverslip type (described above) a good outgrowth of amœboid elements was obtained. Subsequently, instead of using hollow slides, preparations were put up between two coverslips, vaselined to a slide and separated by a "foot," consisting of pieces of thin glass. The pieces of mantle cavity wall were cut up on small plates of celluloid; this prevented the cataract knives from becoming blunt so easily. The preparations were kept at room temperature in large petri dishes containing damp cotton wool to prevent excessive evaporation.

When left for 24 hours such preparations showed a copious outgrowth of amœboid elements, in some cases completely surrounding the explant; vesicular structures were also produced. After a day or two, however, growth ceased completely, the amœbocytes changed in form, became rounded off and died, and large aggregations of these cells were commonly found. Vast numbers of bacteria were present at this stage, and probably were mainly responsible for the death of the culture.

Another medium, Hédon Fleig saline, was next substituted for ordinary Ringer, and much more satisfactory results were obtained. This saline contains the following substances:—

$NaCl$	7 grms.
KCl	0·3 grm.
$CaCl_2$	0·1 „
Na_2HPO_4	0·3 „
$MgSO_4$	0·3 „
$NaHCO_3$	1 „
Distilled water	1000 c.c.

Twenty-four-hour old preparations made between two coverslips, with Ringer solution and Hédon Fleig saline respectively as media, showed little difference, amœboid elements and vesicular outgrowths being produced in both; after 2 or 3 days, however, those made up in Hédon Fleig solution showed a very marked improvement. The Ringer preparations had by this time ceased to grow, and showed signs of degeneration, but the cultures put up in Hédon Fleig saline showed remarkable outgrowths of amœbocytes, in many cases several millimetres wide, organized into a network with large spaces here and there. Migration of mantle and shell epithelial cells was also evident. The extra duration of these cultures is particularly noteworthy; in some cases the amœboid elements appeared quite healthy for over a week. Outgrowths were usually at their best about the fourth or fifth day, after which necrotic changes set in, such as clumping and rounding off of the amœbocytes; instead of the network of extended amœbocytes, large and small aggregations of rounded amœbocytes were common. The dying amœbocytes which comprised these clumps seemed choked with phagocytozed bacteria and general detritus. Such phenomena always marked the approach of the regression of the outgrowths. In Ringer preparations this clumping of amœboid elements very often took place after 24 hours, but the use of Hédon Fleig solution postponed it considerably, i.e., the employment of a more favourable medium lengthened the duration of the culture. In some cases it was found that by carefully adding fresh saline with a fine capillary tube between the two coverslips, the cells of the outgrowth remained healthier and lived longer before clumping. This observation led on to the introduction of a method designed to allow easy and constant irrigation. A hollow slide was vaselined along the two sides, and three or four pieces of mantle cavity wall placed on the slide between the hollow and one end. The explants were then covered with saline solution and a long coverslip placed over them, leaving half of the hollow in the slide exposed. This method abolished complications arising from evaporation, for it was possible to fill up the reservoir with fresh saline without disturbing the preparation in any way. It was thought that it would also provide a means of preventing excessive increase of bacteria, which certainly seemed to be a factor of retarding the continuous growth of the preparation. It was quite possible after a few days to draw off the old liquid and to introduce a new supply, and in cases of bad bacterial contamination the whole preparation could be washed through several times. Attempts were also made to employ the natural antibodies of the snail, blood being introduced for a short period in an endeavour to eradicate the bacteria, and then being replaced by Ringer. This method, however, was not very successful, for though many bacteria were removed by repeated washings, after growth had proceeded for some days, it has not yet been possible to prolong the cultures beyond those made by the ordinary double coverslip method.

An important consideration was the determination of the *p*H of the various media employed. By the capillator method (B.D.H. Indicators) the *p*H

of snails' blood as also that of Hédon Fleig solution was found to be 8·4. The laboratory Ringer made up for cold-blooded animals had a much lower pH value, 7·6. Hence, it seemed likely that the fact that the pH of Hédon Fleig saline was practically identical with that of the blood was a strong reason for the improved growth obtained in this medium.

The employment of various other types of artificial media did not prove as successful as the use of Hédon Fleig solution. Fleisch saline was made up as follows :—

NaCl	7 grms.
KCl	0·2 grm.
$CaCl_2$	0·2 ,,
$MgCl_2$	0·2 ,,
$NaHCO_3$	20 c.c. N solt.
H_3PO_4	3·5 c.c. N solt.
HCl	8·0 N solt.
Distilled water	1000 c.c.

The pH of this solution was 5·2. The use of this medium gave no very satisfactory outgrowths. Another medium tried was Ringer Locke Lewis, of which the constitution was as follows :—

NaCl	7 grms.
KCl	0·42 grm.
$CaCl_2$	0·25 ,,
$NaHCO_3$	0·2 ,,
Glucose	2·55 ,,
Tissue extract	200 c.c.
Distilled water	1000 ,,

To prepare the tissue extract, the foot muscle of about twenty snails was minced up finely and boiled with a little water for 2 hours. A deep yellow liquid was obtained, which was filtered, and the correct proportion of filtrate added to 100 c.c. of saline. The pH of this medium was 5·4. Cultures made up between two coverslips with Ringer Locke Lewis as a medium did not give satisfactory results. A few vesicular structures were obtained, but amœboid outgrowths were either very slight or entirely absent.

Another attempt was also made to investigate the effect of the inclusion of tissue extract. The extract was prepared as before, but this time 5 c.c. of the liquid were added to 20 c.c. of Hédon Fleig solution. Preparations were then put up both in normal Hédon Fleig and in the saline plus tissue extract. The pH values of these solutions were approximately identical, 8·4. In nearly all the cultures excellent outgrowths of amœbocytes occurred, but there was little to choose between those grown in Hédon Fleig solution and those grown in saline to which tissue extract had been added ; if anything, slightly better results were obtained by using normal Hédon Fleig solution. In this also, therefore, the addition of tissue extract did not appear to have

had any beneficial effect on the medium, growth not being sustained longer than previously. One explanation of the failure in this case was that the preparation of the extract was probably faulty. At a later stage further attempts at improving the medium were made by adding proteoses, trypsin broth, etc., to the Hédon Fleig solution. To prepare the proteoses, a modification of Murray's technique for flat worms was employed, digests of snail tissue being used. The albumen glands from several snails (weighing about 1 grm.) were placed in 30 c.c. $\frac{N}{20}$ HCl, together with a small quantity of pepsin, covered with a thin layer of toluol and incubated at 40° C. for several hours. After this, one volume of distilled water was added, the pH adjusted to about 7·4 with normal NaOH, and the mixture boiled down to about 10 c.c. This was added to 200 c.c. of Hédon Fleig solution. Another medium was prepared by addition of trypsin broth to Hédon Fleig solution. On the whole, these modifications of the medium brought no marked success, the resulting outgrowths being neither conspicuously larger nor longer lived than those grown in normal Hédon Fleig solution.

A consideration of the data obtained by the use of various artificial media shows that the best results were obtained by using Hédon Fleig saline, which ensured regular emigration, the cells remaining active for several days and forming organized networks of connective tissue. The maintenance of a constant pH value for the medium constituted a difficulty. The pH of freshly made Hédon Fleig saline was 8·4, but it was found that after a few days the pH of the solution had changed considerably. Loss of CO_2 from the sodium bicarbonate was responsible for this change in the pH. This instability of the medium was definitely prohibitive of good growth, cultures started in stale saline seldom giving good results ; it is possible that the fact that growth ceased after a few days was in part due to the altered pH value of the medium. Among other objections to the technique is the fact that actual outwandering of cells proceeded only for a few days after which death ensued, due to some or all of the following causes :—lack of sufficient nutriment and oxygen in the medium, changes in pH, general accumulation of toxic products, and increasing ravages of bacteria. Despite these difficulties, it has been possible to obtain continuous outgrowth in the presence of a large and ever-increasing bacterial infection, and to provide interesting material for research on living cells in vitro.

While the mantle cavity wall provided much the best material for obtaining outgrowths, various other organs were also used, i.e., flagellum, digestive tract, and salivary gland, grown in Hédon Fleig saline. Certain ciliated portions of the flagellum proved interesting when used as explants, for the cilia continued their movements for several days. Small outgrowths of amœbocytes were obtained, and also curious vesicular structures, probably similar to those previously described from the mantle cavity wall.

The migrated amœbocytes and epithelial cells provided excellent material for cytological study. Observations could easily be made concerning the

reaction of these cells to neutral red, dahlia violet, trypan blue, and other vital stains. It was found that the addition of traces of these stains to the Hédon Fleig solution in which the explants were placed from the beginning did not apparently interfere with the outgrowth of the cells. It is also possible to make the preparations in the normal manner in Hédon Fleig solution, and then after a day or two introduce a few drops of the stain. This method, however, is apt to disturb the culture, and is unnecessary except in the case of toxic dyes, e.g., Janus green, the presence of which hinders the outgrowth of cells.

2. Aseptic Methods.

While considerable outwandering of amœbocytes and other cells was obtained even in presence of bacteria, it was thought desirable to try to obtain sterile cultures with the power of improved and more lasting growth. Investigations in this respect were undertaken by Hill and Macdougald. As mentioned previously, in vertebrates, embryonic tissue, naturally sterile, may be used, and aseptic preparations obtained, provided the usual precautions against bacterial contamination are observed in handling glassware, media, instruments, etc. In *Helix* tissue, however, especially where pieces of mantle cavity wall are cultured, bacteria are always present, and therefore some means of removing them must be found.

The method usually adopted for such sterilization is repeated rinsing in sterile saline solutions, but this method, as well as being tedious, was not found very reliable. Chemical disinfection was not considered possible, because it was thought that compounds sufficiently strong to destroy bacteria would have deleterious effects on the explants, and, furthermore, the mucus which is produced by pieces of snail tissue makes complete washing a difficult operation.

There remained the method of sterilization by exposing the tissue to the action of ultra-violet radiation. Experiments were first carried out with plates of resistant bacteria, and it was found that an exposure of 4 minutes at 40 cm. from the source of radiation completely killed the bacteria. Dr. Margaret Murray (1931), in her experiments on tissue culture in Planarians, used ultra-violet radiation for the same purpose, and exposed the living animals for 4 minutes at 44 cm. distance. It was therefore decided to make an attempt at sterilizing the pieces of snail tissue by similar methods.

One other method was also used, consisting of soaking pieces of tissue overnight in sterile snails' blood and then mounting them in the usual manner. The antibodies present in the blood destroy the bacteria, and have no injurious effect upon the tissue. Since snail blood does not normally clot, the tissue can be mounted in a fashion similar to that treated by ultra-violet radiation.

Where the medium was concerned, some difficulty was experienced in obtaining sterile $NaHCO_3$ solution, since CO_2 is given off and

Na_2CO_3 formed even if the solution is exposed to air at ordinary temperature ($2NaHCO_3 = Na_2CO_3 + H_2O + CO_2$). This decomposition is accelerated by the application of heat, and therefore sterilization at 100° C. for 10 minutes in a steamer, as was employed for the other salts, was impossible. Experiments in this connection, carried out on a fresh 1 p.c. $NaHCO_3$ solution, showed that an initial *p*H of 8·6 (B.D.H. capillator, using Thymol Blue) rose after 10 minutes at 100° C. to *p*H 9·0, and after 40 minutes to *p*H 9·4. Filtration to remove bacteria was therefore carried out, and the solution was stored in tubes plugged with cotton wool and sealed off with paraffin wax, and in the one or two cases where the *p*H was slightly high, it was reduced by adding a few drops of sterile NaH_2PO_4 solution. Probably the ideal method of storage would be to use test tubes which could be drawn out and sealed off after having been filled.

It is unnecessary to describe the details of the technique for preventing bacterial infection, an account of which may be found in many publications dealing with vertebrate tissue culture, e.g., Strangeways' "Technique of Tissue Culture in vitro." Although no separate room was available for the work, the usual instructions for disinfection of the bench and general surroundings were carried out.

The glassware was prepared and sterilized in the conventional manner for use in tissue culture, and the usual precautions against sepsis, i.e., flaming the mouths of tubes, etc., were observed. It was found advisable to sterilize a large sheet of plate glass covered by an inverted pneumatic trough, in which to keep the slides during the mounting of preparations. Instruments were sterilized in the usual manner, the cataract knives in tubes in the air oven, the other instruments by boiling. All cutting of tissue was performed on celluloid plates contained in petri dishes and sterilized in the steamer.

The sole method used for cultivation was a modification of the double coverslip technique, previously described. Instead of affixing a coverslip to a slide by means of vaseline, putting a glass "foot" between to prevent crushing of the explant, and finally covering the preparation with a second coverslip, a method had to be devised to allow the complete sealing off and prevention of contamination. After experimenting with a ridge of vaseline run completely round the edge of the lower coverslip while molten, and allowing it to solidify, it was found that if the upper coverslip was wetted by the medium, as happened quite frequently, a seal between the vaseline and the glass could not be effected. Subsequently paraffin wax, and, finally, a mixture of paraffin wax and beeswax, was used for sealing off; the technique consisted of first fixing the lower coverslip to the slide by painting a ridge of melted wax around it by means of a camel hair brush, increasing the height of the ridge with more wax, and then, when the preparation was to be sealed off, placing the other coverslip so that it rested upon the ridge, and sealing it down by painting more molten wax around its edges. In most cases, by using a mixture of paraffin wax with a small proportion of beeswax, hermetically sealed preparations were obtained, but with pure paraffin wax,

even of a low melting point, cracking and consequent drying up usually occurred.

The medium used was of the same composition as that used in non-aseptic work, namely, Hédon Fleig saline. The solutions of the various components were distributed as follows, 150 c.c. of distilled water being used in each case :—

A.	$NaCl$ ..	.. 4·2 grms.	*B.*	Glucose ..	.. 6 grms.
	KCl ..	.. 0·18 grm.	*C.*	Na_2HPO_4 .	.. 3 grms.
	$CaCl_2$ ..	.. 0·06 „	*D.*	$NaHCO_3$ ..	.. 9 grms.
	$MgSO_4$	.. 0·18 „			

Solutions *A*, *B*, and *C*, having been accurately weighed out and brought up to 150 c.c., were placed in Pyrex flasks, plugged with cotton wool, and sterilized by heating for 40 minutes at 100° C. in the steamer. Solution *D*, as mentioned above, was sterilized by filtration and stored in sealed test tubes.

The medium having been mixed and the slides prepared and placed ready for use underneath the pneumatic trough, sterile glass capsules were placed in sterile Petri dishes, two being allowed for each piece of tissue to be cultured, and medium pipetted in with a sterile pipette.

A snail which had been kept overnight at room temperature was taken and the shell swabbed with 70 p.c. alcohol to remove dirt. The shell was cut away, and a piece of mantle cavity wall removed in exactly the same way as in the non-aseptic method. This piece was immersed in the solution contained in one of the capsules. The capsule was placed at 40 cm. distance from the burner of an ultra-violet lamp, the whole of which had been carefully swabbed with lysol, the burner having been finally washed with absolute alcohol. When the intensity of the radiation had become constant (the lamp was allowed to run for 15 minutes) the lid of the Petri dish was removed, and the fragment of tissue irradiated, being turned after 2 minutes with sterile forceps. When 4 minutes had elapsed, the fragment was transferred as quickly as possible to the other non-irradiated capsule, to prevent the tissue being affected by any toxic substance which might have been produced by the action of the ultra-violet radiation on the saline. The pieces of tissue were then cut up in the manner described previously, save that the knives and celluloid used had been sterilized. The fragments were then mounted between two sterile coverslips, hermetically sealed with paraffin wax, and kept at bench temperature.

In place of this irradiation method, sterilization may also be effected by keeping the pieces of mantle cavity wall in small dishes of blood overnight. They are then rinsed in sterile saline before being mounted as described above.

Following this aseptic technique, a series of sterile cultures was obtained, which exhibited continued growth for about 14 days and survived in a healthy condition for several weeks. In aseptic mounts the amœbocytes lay further apart, were more flattened, and rarely showed a tendency to

unite to form either spaces or groups. An important point is the similarity of appearance of outgrowths from explants sterilized either by radiation or by immersion in blood. On the whole, it has not been possible in our sterile preparations of mantle cavity wall to provide such mass migrations of cells as were obtained by the original non-aseptic methods. In fact, it seems that little improvement was actually contributed to the outgrowths by the introduction into the technique of precautions against sepsis. Undoubtedly the period of outgrowth was extended by this modification, but in sterile mounts the outgrowing cells did not organize a connective tissue network comparable to what is found in the normal pulmonary cavity wall; this type of outgrowth was exhibited only in septic mounts.

Having dealt with the technique of "in vitro" cultures of *Helix* carried out in this laboratory, we must now notice the investigations of another worker in this field. In 1933, Premysl Bohuslav published two papers dealing with the results of his work on the tissue culture of pulmonate molluscs. As Gatenby and his students carried out their observations quite independently of this worker, it is interesting to compare their results and methods. Bohuslav does not mention having used the mantle cavity wall from which we have obtained the most vigorous outgrowths, his explants being taken from the digestive tract, salivary gland, receptaculum seminis, and heart (atrium) of various *Helicidæ*. He does, however, claim a survival period of several weeks for his outgrown cells. It would not be possible to give a full description of his results, but, as he has exhaustively examined the various problems presented by the technique, it was thought that some account of his method would prove helpful.

Bohuslav dealt intensively with some of the difficulties which have to be surmounted in invertebrate tissue culture when an attempt is made to follow the conventional methods used in vertebrate work. In the first place, he emphasized the fact that owing to the non-sterility of the body surface, it was difficult to extract the tissues inside, so that they would be in a sterile condition. He found the use of embryonic tissue impossible owing to the minute size of the embryo, and even in adult tissues the small size often constituted a difficulty, as well as their semifluidity, which rendered them liable to bacterial infection. It is interesting to notice that Bohuslav considered the blood of little value, firstly because of its scarcity, and secondly because what blood is present contains insufficient nutritive material. Concerning the preparation of tissue extract, he regards the only possible method to be maceration of the whole body of the animal in water, but this he admits to be exposed to the criticism that it allows of the introduction of many substances prohibitive of growth. He has observed that in many invertebrates definitely toxic substances are produced in certain organs. Other difficulties in the way of preparing a medium such as is normally used in tissue culture are that preparation of embryo extract is impossible owing to the small size of the embryo, and also that since in invertebrates blood does not coagulate, a natural supporting medium is not provided. He

therefore experienced considerable difficulty in his choice of a medium. He decided that neither vertebrate blood plasma nor agar would be suitable, as they would tend to introduce foreign proteins. Other objections to the use of agar was that he found it to be accompanied by unknown proteins arising in its manufacture, and also that it was liable to attack by bacteria. After unsuccessfully trying gelatin, wadding, glass wool, spiders' webs, and fine fibrin to act as supports for the cultures, he decided to abandon all supporting media as unnecessary ; in fact, he obtained growth in media which contained no component added to increase its consistency. He considers that in invertebrates the blood is much less dense than in vertebrates, containing only dissolved proteins, and hence since no support is provided in the natural state, it is not generally necessary in tissue culture.

After these preliminary investigations he decided to employ an artificial medium, the chemical composition of which was regulated to correspond to the natural physiological needs of the tissue. As the basis of his solution he used a 3-p.c. solution of peptones prepared by peptic digest of ox fibrin or certain parts of the snail, e.g., albumen gland or muscle tissue. He found that the most effective medium was a mixture of ox fibrin peptones and those obtained from fresh homologous media in the ratio of 3 : 1. These peptones were obtained by employing the usual technique, i.e., by peptic digestion in the presence of HCl (+ a few drops of Toluol) followed by centrifuging, sterilization, and neutralization with NaOH. To this solution were added glucose and mineral salts, of which the isotonic amounts were carefully calculated. The resulting medium had the following composition :—

NaCl	0·74 p.c.
KCl	0·045 p.c.
$CaCl_2$	0·05 p.c.
$MgCl_2$	0·002 p.c.
$NaHCO_3$	0·015 p.c.
NaH_2PO_4	to bring *p*H to required point.
Glucose	0·060 p.c.
Proteose	3·1 p.c.

This was found to be most favourable for promoting growth in *Helix pomatia*, *H. obvia*, *H. austrica* and *Arion impiricorum*, from which explants of digestive tract, salivary gland, and receptaculum seminis were used. He determined the optimum *p*H from the blood of the animal used, and in the above-mentioned molluscs found it to lie between 6·8 and 7·4.

A comparison of these conclusions, with regard to the composition of the medium, with those reached by the workers in this laboratory is interesting. Bohuslav considers blood useless as a medium,* claiming that it produces toxic substances, and hence is most unfavourable for growth. On the other

* *See* footnote on p. 175.

hand, according to Gatenby, the blood contains antibodies which keep down the activities of the bacteria. With regard to artificial media, both the present writer and Bohuslav experienced similar difficulties in their efforts to increase the viscosity. Hédon Fleig solution, which is chiefly advocated by Gatenby and his students, has a very similar composition (with the exception of proteose) to Bohuslav's solution, though it is noteworthy that the latter contains only 0·06 p.c. glucose, as compared with 1 p.c. in Hédon Fleig solution. An interesting point is the *p*H of the media; 8·4 was found to be the *p*H of the blood of *Helix aspersa*, and hence the most favourable medium had a similar *p*H; but for the species of snails used by Bohuslav, e.g., *Helix pomatia*, *H. obvia*, and *H. austrica*, a much lower *p*H seemed to be suitable. Although Bohuslav has carefully worked out the required amount of proteose, he does not disclose the actual details of the method used. In this laboratory, Macdougald and the present writer have tried the addition of proteoses to their media, but never met with greater success than without this modification.

Bohuslav recognized that the production of sterile preparations presented special problems. He first tried disinfection of the tissue by means of chemical antiseptics (phenol, salicylic acid, absolute alcohol, thymol, salol, etc.), but found this neither favourable nor adequate. Failure was due principally to the fact that a layer of mucus was produced by the tissues on being brought into contact with the antiseptic, and the penetration of the antiseptic through the slime layer was very uncertain. Another observation was that this mucous sheath checked nutrition by hindering the access of the tissue to the medium and to oxygen, and also the removal of products of metabolism. In addition, he found that the osmotic pressure was affected by the mucus, and finally concluded that since chemical disinfection caused a pathological condition, it was useless for this type of work.

Bohuslav next tried sterilization by rinsing the fragment of tissue in a series of solutions of sterile Ringer. He considered this method quite satisfactory, while admitting it to be unreliable. It has the additional disadvantage of being rather a lengthy process, so it seems a pity that after his intensive investigations Bohuslav could not have devised some better method of sterilization. Certainly this rinsing method seems a weak point in the technique. He did not approve of disinfection by means of ultra-violet radiation, stating it to have a deleterious effect on the tissue. Here again, therefore, we find a difference in opinion between Bohuslav and the workers in this laboratory. We claim that exposure to ultra-violet radiation has no deleterious effect on the pieces of tissue, support being given to this view by the sterilization in a similar manner of planarians by Dr. Murray.

Bohuslav made hanging drop cultures, but found a slight modification beneficial. Since the medium was rather mobile, a circle of wax was drawn by means of a hot glass rod on the coverslip, leaving a space within having a diameter of 1·5 cm. in whose centre the drop was placed. Several explants were placed in the one drop. The coverslip was detached after a few days

and the medium changed with a pipette. Bohuslav succeeded in making sub-cultures, a feat which so far has not been accomplished in this laboratory.

Bohuslav's best examples of amœbocytic networks were obtained from explants of heart and receptaculum seminis. His photographs of receptaculum seminis show quite good outgrowths of stellate connective tissue cells at 8 days, which seem to survive for several weeks. His methods keep the cells healthy for longer periods, but, on the whole, he has not obtained very large outgrowths. The most remarkable outgrowths were obtained from atrium explants * grown in a specially modified solution of which the composition was as follows :—

$NaCl$	0·74 p.c.
KCl	0·042 p.c.
$CaCl_2$	0·048 p.c.
$NaHCO_3$	0·010 p.c.
NaH_2PO_4	to give pH 6·8.
Glucose	0·200 p.c.
Proteosis	3·1 p.c.

An unusual modification of the hanging drop culture was used ; Bohuslav considered that the drop should be small enough for the tissue to touch the coverslip and so inverted the preparations, which were thus not really "hanging" at all. He kept the outgrowing cells from atrium explants alive for over a month, but little differentiation into organized tissue was obtained.

As regards supra-vital staining Bohuslav found that when the stains were employed from the outset, no growth occurred, hence it was necessary to add them to changes of media subsequent to the first.

My thanks are due to Mr. T. J. Macdougald for his kind assistance.

Summary.

Non-Aseptic Technique.

1. Gatenby obtained outgrowths of amœbocytes and other cells by keeping pieces of mantle cavity wall of *Helix* in hanging drops of blood.

2. Hill slightly modified the technique, using artificial media, of which Hédon Fleig solution was the most satisfactory, giving more regular emigration of cells which lasted several days and produced a well-organized connective tissue network.

Aseptic Technique.

3. Hill and Macdougald, taking the usual precautions against sepsis, sterilized the explants either by exposure to ultra-violet radiation or by

* The atrium explant is being reinvestigated by Miss I. Haughton, who has shown that by wounding the snail a few days previously to making the explants a 100 p.c. outgrowth of the preparations is guaranteed in blood mounts put up without aseptic precautions.

soaking them in blood. The amœbocytes were more flattened and did not unite to form a definite network. The life of the cultures was much prolonged.

4. Bohuslav's exhaustive attempts to perfect the technique did not result in very extensive outgrowths, although he kept the cells alive and apparently healthy for several weeks.

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XII.—ON THE CORRECT WRITING IN FORM AND GENDER OF THE NAMES OF THE FORAMINIFERA 593. 12.

By W. A. MACFADYEN and E. J. ANDRÉ KENNY.

STUDENTS of the Foraminifera are not remarkable for unanimity, but on the point that the latinized names of their specimens should be correctly written there can hardly be two opinions. Unfortunately, a survey of the literature shows that authors are either not interested in the precise application of the International Rules of Zoological Nomenclature,* particularly of Art. 14, or perhaps, if it may be said without discourtesy, their classical knowledge is not equal to the strain. There is no single publication on the Foraminifera which will give the inquirer adequate guidance, and few authors are consistent in their usage. Brady's Report on the *Challenger* Foraminifera may be taken as one of the most consistent guides, though we differ from him in two cases; but it is inadequate to-day on account of the many new genera erected since 1884, and the re-introduction of many old generic names antedating and invalidating those used by Brady. Fortunately, we need not consider many difficult generic names proposed, particularly by Montfort, Ehrenberg, and de Folin, since a number of them have been shown to be synonyms or mere *nomina nuda*. It is only necessary to consider here the valid generic names in use at the present day; but amongst these are some which are obviously difficult.

The present note represents the collaboration of a student of the Classics with a student of the Foraminifera. Begun as a private study to help one of us to avoid solecisms which he would be the first to regret, it was later thought that a note of the results might be welcome to others. It will serve its purpose if it help authors to eliminate some of the errors so often seen in the nomenclature with which we are concerned. The abundance of the criticism the paper has received in manuscript from friends who have been kind enough so to help us, is a measure of the difficulty of various points, and the manuscript has, in fact, been redrafted five times in an endeavour to incorporate much of this criticism.

i. *Generic Names.*

Unless there be some reason to the contrary the gender is determined by the ending of the Generic name as follows:—

* Reprinted in the *Proc. Biol. Soc. Washington*, xxxix, 30 July, 1926, pp. 75–103.

Masculine :

-ides, as *Cibicides*.
-ites, as *Orbitolites*, *Lenticolites*.
-oides, as *Haplophragmoides*.
-etes, as *Microcometes*.
-orbis, as *Discorbis*.
-siphon, as *Bathysiphon*.
-us,* as *Ammodiscus*, *Cycloclypeus*.

Feminine :

-a (generally), as *Astrorhiza*, *Buliminella*, *Calcituba*, *Cymbaloporetta* *Dendrophrya*, *Earlandia*, *Endothyra*, *Glomospira*, *Gonatosphæra*, *Lagena*, *Lituola*, *Marginopora*, *Miliola*, *Myxotheca*, *Orthoplecta*, *Patellina*, *Saccammina*, *Sigmomorphina*.
-opsis, as *Bolivinopsis*.
-taxis, as *Tetrataxis*.

Neuter :

-trema, as *Amphitrema*.
-um, as *Ataxophragmium*, *Loxostomum*.†

There are a number of generic names which fall outside the above scheme. Since their genders are not obvious a list is given below.

Masculine :

Archaias.†
Borelis.†
Nonion.†
Psammonyx.
Reophax.†

Feminine :

Amphicoryne.
Cancris.†
Haplostiche.
Heterohelix.
Peneroplis.†
Plagiophrys.
Psammophax.
Sulcophax.
Pyrgo.‡
Rhaphidoscene.

Neuter :

Diaphoropodon.
Haliphysema.
Polyphragma.
Psammatodendron.

ii. *Specific Names*.

Where the specific name is in the form of an adjective its termination must be inflected to agree with the gender of the generic name. It would seem an impertinence to suggest that when a species is transferred from one genus to another whose name is of a different gender, such a specific name must be inflected to agree with the gender of the latter. But many instances might be cited to show that even this elementary point is often overlooked.

There are admissible under Art. 14 of the Rules, and in use, many specific

* It is possible for a generic name ending in *-us* to be a Latin fourth declension feminine noun. No such generic name in the nomenclature of the Foraminifera seems, however, to be in use.

† See below.

‡ A Greek proper name; she was the nurse of Priam's children; Vergil, Æneid V, line 645.

names which are not inflected, since they are nouns in either the nominative or genitive cases. Such names are often a stumbling-block to the unwary.* The following list gives a few of the better known examples :—

(*a*) Nouns in the nominative case in apposition :

acus †
bacillum
bombyx
calamus
capreolus
clypeolus
comma
digitale ‡
discus
discolites
doliolum

ephippium
faba
filum
flagellum
folium
funiculus
gladius
globulus
hamus

lituus
  semilituus
  sublituus
mamilla
manubrium
monile
  pseudomonile
multisepta
ovum
ovulum
pedum

pileolus
placenta
proteus
raphanus
raphanistrum
sacculus
scalprum
scapha
sceptrum
secale
seminulum
*tuba**

(*b*) Nouns, often proper names, in the genitive singular or plural such as :

aliciæ
antillarum
cornucopiæ
cretæ

haidingeri
icenorum
montis-calvi
plummeræ

iii. *Varietal Names.*

The correct inflection of varietal names, where these are in adjectival form, seems to be often misunderstood. There can be no doubt that the word that is qualified by the varietal name, whether inserted under the abbreviation "*var.*" or omitted in the subspecific mode of writing the variety, is *varietas*. This is a feminine word, and the varietal name should therefore invariably be in the nominative singular feminine, irrespective of the gender of either generic or specific name. This rule will fortunately apply even where the variety is written "*forma*," "*mutatio*," "*subspecies*," or "*premutatio*," since all these words are feminine. Thus we should write *Elphidium incertum var. clavata ; Haplophragmium humboldti var. lata ; Haplophragmoides latidorsatus var. papillosa ; Nonion umbilicatulus var. depressula ; Nonion scapha var. inflata ; Cibicides lobatulus var. ornata.*

Since, by Art. 11 of the Rules, subspecific (or varietal) names are subject to the same rules as specific names, they may also be nouns in the nominative or genitive.

iv. *Points of Difficulty.*

Some generic names from their form give no indication of their gender, beyond that they are either masculine or feminine. These are usually

* The most frequent sin of the unwary is to inflect these names as if they were adjectives, with the result that one is all too frequently presented with words like *seminula,* bastards that masquerade as adjectives.
† = a needle ; a feminine word.
‡ = a thimble ; not to be confused with the adjectival *digitalis.*

either Latin adjectival forms in *-is*, which are to be distinguished from Greek feminine substantive forms in *-is*, or Greek forms in *-as*. Here the gender should be accepted as that given by the author who erected the genus, if that be ascertainable. *Archaias* Montfort and *Borelis* Montfort are of uncertain gender, and the first (and only) species given by Montfort, *A. spirans* and *B. melanoides*, give no clue. They are here assigned to the masculine on the ground that Montfort translated them into French as masculine, *Archidie spirant* and *Borélie melonné*.

There are a few cases where the generic name is a *vox nihili*. Unless the structure of the word happens to show them to be definitely of a particular gender, as in the case of *Peneroplis* and *Cancris*, nothing can be done with them but to accept the gender originally given. Such words are *Reophax* Montfort, and *Nonion* Montfort. No plausible derivation can be suggested for *Reophax*, unless it can be connected with *rheon* (ῥῆον), the word for rhubarb in Dioscorides. Nor has *Nonion* any apparent etymology, for it is not, as has been suggested, the name of a Greek god in Æschylus or, apparently, elsewhere. However that may be, Montfort wrote them in the masculine, naming his first species *Reophax scorpiurus* and *Nonion incrassatus* respectively, so this gender should be retained.

Montfort, however, was not meticulous, and sometimes he assigned wrong genders to his genera. Thus *Peneroplis* and *Cancris*, which are definitely feminine forms from consideration of the structure of the words, though without apparent etymology, he assigned to the masculine, as *Peneroplis* [*p*] *lanatus*, *Cancris auriculatus*. While his usage should thus be taken as the sanction for determining the gender of his names failing any better reason, it must be regarded as an excuse for following a lead in an otherwise uncertain matter, rather than as an essential verity.

An interesting case is the name of the genus *Loxostomum* Ehrenberg. This is a neuter adjective used as a noun. Some authors, however, have lately taken it upon themselves to alter it to the false neuter substantival form *Loxostoma*, probably on analogy with the many genera of other groups with compound names ending in *-stoma*.* In accordance with Art. 19 of the Rules, however, the original *Loxostomum* should be preserved. Curiously, the name *Cribrostomum* v. Moller, an exact analogue, has been left in its original form.*

Art. 19 of the Rules states that "The original orthography of a name is to be preserved unless an error of transcription, a *lapsus calami*, or a typographical error is evident." Names, therefore, except in strict accordance with this rule, must not be altered by later authors to conform to their individual preference. For instance, until recently when Cushman went back to the original spelling, the name *Uvigerina pigmea* d'Orbigny had been

* It happens that both these genera (*Loxostomum* and *Cribrostomum*) were provided in the first place with names having correct grammatical forms. We are only justified in altering *Loxostoma* to *Loxostomum* because *Loxostomum* was the form first used. The names of Genera in other groups cannot be tampered with, whatever solecisms may have been committed in their formation.

almost universally altered by authors to the classical form *U. pygmæa.* But *pigmea* is a common later spelling, and there is no doubt that it must be retained.

A final surprising error to be found in some recent descriptions of Foraminifera is the formation of " double plurals " from Latin neuter nouns which have become assimilated into scientific English. Thus *punctum* and *septum* become in the plural *puncta* and *septa,* but we are not seldom presented with the erroneous feminine-looking words *punctæ* and *septæ.*

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XIII.—A NEW TYPE OF PORTABLE MICROSCOPE.

By John N. McArthur, M.R.C.S., L.R.C.P.

(*Read December 20th*, 1933.)

Three Text-Figures.

A portable microscope, to justify its existence, should have the following qualities: It must be light; it must occupy little space; and at the same time must be sufficiently robust to meet the extra strains imposed upon a

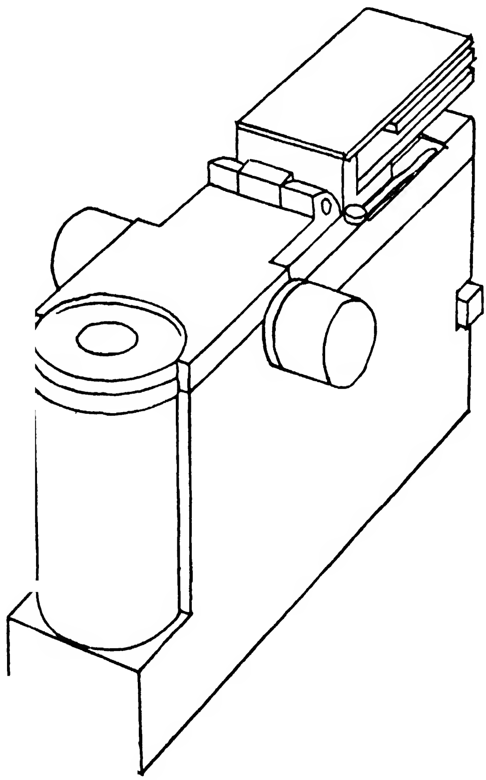

Fig. 1.

portable instrument. It should, if possible, be operable in the hand without a table; it must be ready for use without a great deal of setting up and adjustment, and it must be capable of the same quality of work as the large model.

This cannot be achieved satisfactorily by modifying the conventional microscope, as that can only be done by making it collapsible, a compromise between rigidity and lightness, with the inconveniences of setting up, and of packing away after use.

The instrument described is an attempt to achieve these qualities by a radical departure from the conventional design; a departure which at the same time opens up possibilities of further advance in microscope design along lines which are impossible with the older model. It is a microscope which has the abilities of a large stand instrument, but with greater rigidity, greater simplicity, and a number of other advantages; but although carrying three standard objectives, it is small enough to go into the pocket, and weighs proportionately little.

The following diagram will illustrate the principle of the design :—

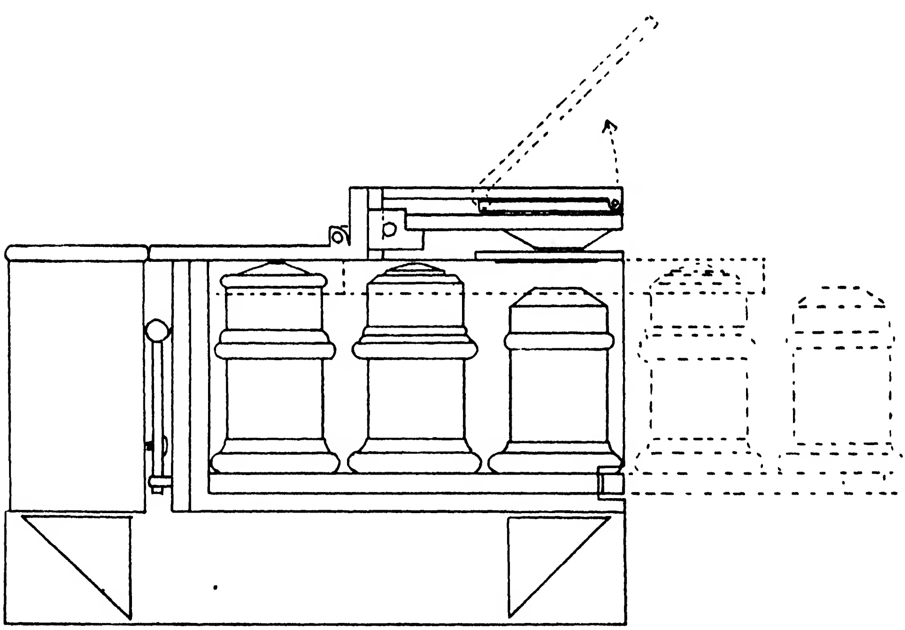

Fig. 2.

The instrument consists, essentially, of a standard objective, looking upwards, an eyepiece looking downwards, and two reflecting surfaces which will pass the light from the objective into the eyepiece. The slide lies above the objective, and face downwards; and focusing is achieved by moving the objective up and down.

In practice, three objectives (say, two-thirds, one-sixth, and one-twelfth) are mounted on a sliding plate, in such a way that each may be brought in turn into position beneath the slide. Focusing is achieved by mounting

this plate for the objectives upon an L-shaped bracket, which moves up and down upon a sliding dove-tail. Movement is actuated by a screw and lever.

This arrangement is enclosed in a casing consisting of a single casting; the objective plate is operated by two lugs which project through the side walls of the casing, and a mechanical stage may be built into the top of the instrument.

A condenser and iris diaphragm, together with a metal mirror, are mounted above the slide in such a way that they may be swung clear of the stage for

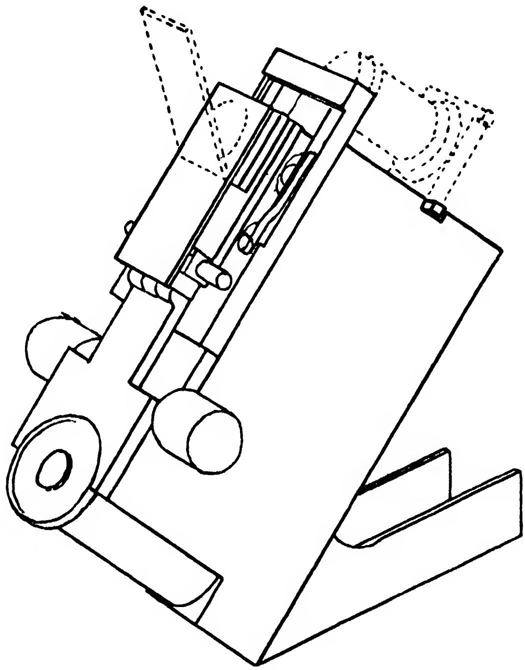

Fig. 3.

access to the slide. This attachment may be removed and replaced by a small electric illuminator, entirely self-contained, and using a small dry battery.

In the bottom of the casing, alongside the light-tube, and occupying the only remaining space in the casing, is a hinged horse-shoe base, upon which the instrument may stand and incline to a convenient angle.

The value of the instrument is not limited to its portability, and it has advantages which might recommend its use as a students' microscope, for laboratory work and research.

In virtue of the inverted slide we have the following advantages :—

Coarse adjustment is abolished, and fine adjustment is reduced to a minimum,

as the object always lies in the same plane, and will not be affected in any way by the thickness of the slide.

The cover-glass of the slide will not be broken by careless focusing, because if the objective is raised too far the slide will be merely lifted from the stage without damaging either slide or objective, although since focusing is minimized the possibility of even this occurring is unlikely.

The object is fully visible to the naked eye, even with an oil-immersion objective, thus parts of a specimen may be picked out by the naked eye and then examined microscopically by the highest powers without removing the slide from the stage.

Lying-drop preparations may be used, in which bacteria are in a flat stratum, and not subject to the same amount of movement as in a hanging-drop preparation.

Micro-dissection and other manipulations can be made under an oil-immersion objective.

An oil-immersion objective may be used with a live-box.

Vertical and unreflected lighting may be used, as well as any other.

The condenser is very accessibly situated. It can be very simply used for oil or water immersion, its aperture is visible and conveniently adjusted, its top lens can be readily removed, and the condenser itself changed with a minimum of trouble.

Further advantages that may be claimed for the instrument are :—

Greater rigidity even than in the conventional model, as the parts are totally enclosed in a single casting.

Less wear and tear on the focusing adjustment, as this is protected by the casing, has a very small excursion, and supports only the weight of the objectives.

The objectives can be more accurately centred, and in better alignment, on a flat surface than on a revolving nosepiece ; and a sliding dove-tail has a greater degree of accuracy than a revolving disc.

More convenient change of objective, as it is unnecessary to take the eye from the eyepiece in order to ascertain the position of any particular objective.

The instrument is quicker and simpler to use than the conventional model in virtue of :—

1. Quicker change of objective ;
2. The elimination of coarse adjustment, and the reduction of fine adjustment to a minimum ;
3. The fact that the slide is more readily grasped than on the conventional model.

The design of the instrument is readily adapted to the making of a binocular microscope, with every refinement which might be required in a large laboratory instrument, as well as being equally applicable to a simple botanical microscope, cast in bakelite, carrying one objective, and made at a very low cost indeed.

571.76. XIV.—THE USE OF THE MICROSCOPE IN THE STUDY OF ANCIENT BEADS.

By Horace C. Beck.

(*Read March 21st*, 1934.)

Fifteen Plates.

It is not generally known how much the science of archæology owes to the science of microscopy. In no branch is the microscope of more use than in the study of ancient beads, but to study them properly a microscope with first-class optical units and several attachments is necessary.

The microscope that I use is rather bulky, and is fitted on a bench made from a lathe bed. This is not necessary, but is a great convenience, as the illuminant is on the same bench, and also the photographic camera.

Although high resolution is not always a matter of the first importance, the frequent comparison of colour of small particles makes apochromatic objectives a great advantage; also they enable one to use an eyepiece $\times 25$ with comfort. I use a binocular body, not usually for binocular vision, although that sometimes is an assistance, but generally with a $\times 6$ compensating eyepiece in the left-hand tube, and a $\times 25$ one in the right-hand tube. In this way the $\times 6$ acts as a finder, an important matter when there are only a few minute chips of transparent glass mounted in balsam on the slide. I also use a double nosepiece. The slight amount of eccentricity got in this manner is corrected by a touch on the screws of the substage centering fitting. For the great majority of my work I have a 16 mm. and 8 mm. objective on the double nosepiece, each fitted with a ring illuminator. This arrangement gives magnifying powers of about 60, 120, 250, and 500.

In some cases when photographing, the flatness of the field is much more important than the resolution, so, to correct this, I find that an iris diaphragm behind the objective is a great assistance. It also perceptibly increases the depth of focus.

Over the eyepiece I have a tourmalin, which can be easily swung in and out. This I find a great advantage over a prism, as the latter is very apt to cause astigmatism, and even more frequently to cut down the field of view when photographing.

The substage has to be arranged so as to give three different kinds of illumination, and to be able to change rapidly from one to the other.

The first kind is what I call "ordinary illumination." This can only be used with transparent objects. To get this I use a 1·3 N.A. achromatic

condenser, and below this a carrier with a motor headlight, and a condenser to parallelize the light. The lamp is connected to accumulators, and an adjustable resistance and ammeter enable a standard light to be procured for photography.

The second type of illumination required is "polarized light." To obtain this a nicol prism is swung in under the substage and the tourmalin over the eyepiece; otherwise the illumination is as for ordinary illumination. It is very important in this case to have a rotating stage.

The third form of illumination, which I call "reflected light," is obtained by the ring illuminator, which throws down on to the specimen a very perfect image of the source of light. The image, however, is very coloured. This is entirely corrected by the Bracey Colour Corrector, which fits into the substage. It is mounted with an adjustable dark well or patch to block out the direct light. It is very frequently necessary to change rapidly from one sort of illumination to another, so I have the Bracey Colour Corrector and the 1·3 N.A. condenser mounted on interchangeable fittings on an Akehurst slide.

Colour screens can be fitted into the substage. They are sometimes useful in photography to increase the contrast.

In studying the small particles of colour, etc., in glasses, it is sometimes necessary to use decidedly higher powers than an 8 mm. When this necessitates an oil immersion, unless the utmost resolution is required, the 3 mm. 1·2 N.A. is to be recommended, as it can be used with a focusing dark-ground illuminator. This gives the best dark ground that one can get for high powers, but it is not so satisfactory as the ring illuminator, as it does not show up the colour of the particles nearly so well.

When I am photographing with a magnification of less than 10, I frequently remove the body and use a 3-inch Microstigmar lens on a simple fitting. When transmitted light is not required, and the magnification is under 8, I generally transfer the lens and camera to a rough wooden vertical bench, which has a small table that can be raised and lowered. A useful fact to be remembered when using direct low-power photography is that once the magnification is set, when fresh objects are to be photographed, the focusing of the object automatically sets it to the right magnification provided that the focusing is only done on the raising table and that the camera and lens are never moved.

After this tedious description of apparatus, let us now see to what use it can be turned in the study of ancient beads.

I think that the best way will be to take a few actual examples.

First I will take a case where the ingredients of a glass were discovered by means of the microscope. There is a very brilliant opaque red glass that was used in the manufacture of beads and pieces of inlay about 1400 B.C. This glass has a curious history, and it has turned up in various places at various periods, one of the last being the red enamel of the Celtic work in England over a thousand years later. A small chip of this glass from a

factory of the time of Tutankhamen was examined under the microscope. This is shown in fig. 1 magnified 100 diam.

Sir Herbert Jackson recognized the crystals in it as being cuprous oxide, and proceeded to make a glass on the same lines. He has been very successful. The colour of his glass is equal to the best Egyptian, even where the surface of the latter is broken away, and the crystals he has produced are certainly more striking. A specimen of these is shown in fig. 2. I think this glass can claim to have the most decorative structure of any glass that I know.

At a later date I discovered an orange glass with very similar crystals. Sir Herbert found that these were also cuprous oxide. As no yellow or orange form of cuprous oxide was known, he went into the question chemically, and succeeded in producing a yellow cuprous oxide. He has not, however, produced an orange cuprous oxide glass, although many specimens of his red glass have crystals of yellow cuprous oxide scattered about in them.

In the same factory where this red glass was made about 1350 B.C. they also made another kind of red glass. This has a browner red colour and is also a copper glass. In this case, however, the copper is held in the form of minute spherical particles of metallic copper. These can be immediately distinguished from the cuprous oxide glass if a small portion of a chip is examined under the microscope, the particles of cuprous oxide in the former being red when viewed with transmitted light, whilst the particles of metallic copper appear blue. These two forms of copper glass are very probably made from the same materials, but, if so, the metallic copper glass must have been heated to a considerably higher temperature than the other, so that the oxide has been changed to metallic copper.

In the same factory they also made a material called "faience," which was extensively used to make beads and many other articles. This material consists of fine grains of quartz. which have been cemented together with a little lime or alkali by means of great heat. It was coloured by either mixing a small amount of colouring matter with it before it was fused or else by applying the colour afterwards, almost like a pottery glaze. Generally, the glasses and glazes had similar colours and were made with the same colouring agents. But with the red glasses at the factory at Tel el Amarna a totally different development occurs. The brown red glass and the red glaze have the same colour—at least, it is so nearly the same that I cannot distinguish the difference unless they are placed side by side, and even then it is not easy. But, whilst the glass has no colouring matter in it except copper, the red faience has no trace of copper even when tested with a spectroscope, and the whole colour is produced by iron.

The microscope can differentiate between the copper glass and iron glaze, because, when viewed by transmitted light, the metallic copper glass has great numbers of minute particles which look blue, whilst the iron-red glaze has particles which look almost black; and, further, the metallic copper particles are relatively nearly all the same size, whilst the size of the particles in the iron glaze varies enormously. In fig. 3 is shown a piece of this faience,

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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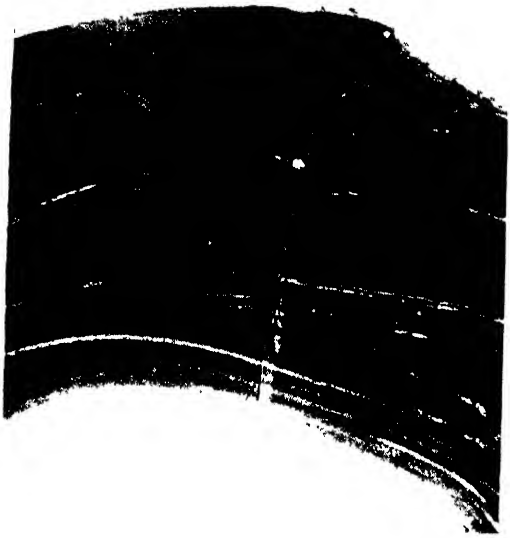

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

demonstrating the large and variable-sized particles, and above it a piece of the copper glass, showing the small particles of uniform size. The magnification is 450, and the average size of the copper particles is about 1/60,000 inch.

The next example that I will take is connected with some small black beads from Rhodesia. A few years ago the British Association met in South Africa. It was thought that it would lend great interest to the meeting if a definite pronouncement could be made as to the real date of the ruins at Zimbabwe and other Rhodesian sites. Miss Caton Thompson was entrusted with the work of carrying out some systematic exploration.

In her excavations she found a number of small black beads, some of which could be dated definitely as not earlier than A.D. 1600 to 1700, whilst others were found under sealed pavements connected with the buildings, and must have been at least as early, if not earlier, than the date of the buildings. Others also came from sites which Miss Caton Thompson thought to be ancient, but this could not be proved, as the sites were not sealed.

There is practically no difference in the black beads when they are examined by a hand magnifying glass, but under the microscope there is a great difference. Fig. 4 is a section of one of the more recent ones. It is a transverse section of part of a small annular bead magnified 50 diameters. The smaller curve at the bottom is part of the perforation, the large black lump is a piece of corrosion. The pebbly looking material at the top is a reinforcing material used to prevent the corroded surface from entirely breaking away. In this case it has only been partially successful, as, due to unequal contraction, it has pulled part away, but it is still almost in position.

The base of the bead is a fairly clear glass, with one or two bubbles and a few specks. The corrosion is considerable.

Fig. 5 is a similar section of a bead found in the Bed Rock Layer at Zimbabwe. It appears to be one of the glasses of which we hear that they "cannot be made without a few small striæ." The convolutions may possibly be explained by stirring when the mixture was too thick, or being made by winding round a wire, but I am quite at a loss to account for the explosion which seems to have started from the white spot on the right-hand side and gone straight through the other layers without affecting them. There were also rays going in other planes from this and other centres, which got ground out as the thickness of the section was reduced.

The most important difference, however, between these two specimens is not their difference with regard to veins, but the fact that the bead of A.D. 1700 is a purple colour, almost certainly due to manganese, whilst the Bed Rock Layer bead has a browny black colour, probably caused by iron.

An interesting point in connection with this investigation was that, in all the sites which Miss Caton Thompson thought to be the same date as the Bed Rock Layer, the black beads were made of a glass with a black colouring material, and with no trace of the purple of manganese. This was a striking confirmation of her opinion as to the date of the sites.

The microscope is also useful for finding out what was the original nature of corroded material.

A few years ago I had some material sent me from Kirkuk, a town in Northern Mesopotamia. The sender, the head of one of the American expeditions, said that he was sending me a small fragment of a bowl, and asking me to let him have my opinion of it. It arrived as a pale pink powder, with a few slightly larger pieces in it. The largest, which measured about 2 mm. in its maximum dimension, had to be treated with great care to prevent it crumbling away. However, I managed to cut a very poor section of it. By studying this, and also the loose dust, the following facts came out:—First, that the bowl had been parti-coloured; secondly, that it had red, yellow, and white parts, and possibly, but rather improbably, black parts; thirdly, that the base of the material was made of fine grains of quartz cemented together; and, fourthly, that the colouring matter of the red was iron, and of the yellow also iron, probably in the form of ferric oxide.

Sir Herbert Jackson very kindly took a spectroscopic examination, which proved that the grains of quartz had been fused together with lime, so making a faience of a similar type to that used so extensively in Egypt.

Another use to which the microscope can sometimes be put is to prove how beads have been made. A number of beads and small shields for inlay have been found at Ur and other places in Mesopotamia and Persia. These are made of quartz, and most of them have a very high polish, whilst some are frosted. I shall refer to these later. The shields can be definitely dated to about 2300 B.C., and many of the beads are probably of the same date, but one string of milky quartz specimens was found in a pot which dated it to as recent a date as 900 B.C.

When first found, these were stated to be sand polished. A careful examination with quite a low power was sufficient to demonstrate that they were not. The first fact that I found which disproved the sand-polish theory was that there were one or two points where the shields had grey patches, which had been ground evidently after they had been polished and before they had been fixed into the decoration for which they had been made. If these pieces of inlay had been sand-polished there would have been no explanation as to how these relatively high portions had been left grey whilst the portions on both sides of them were polished.

A further examination of various specimens of inlay and beads soon convinced me that the surface had been molten at some period. Not only was this shown by the wavy surface, but spots could be found where the liquid material had not quite flowed over the grey under-surface, and had ended off like a frozen wave. This is shown on fig. 6.

Amongst the beads and shields shown, in addition to the high-polished beads, there are some which have a grey or frosted surface. These frosted beads also come from Ur. The frosted surface consists of an innumerable series of conchoidal fractures. The frosted types are almost always made of clear, and not milky, quartz.

By a series of investigations, much too long to explain here in detail, I have proved to my satisfaction, not only that the two types of beads are closely related to each other, but also that they have been made in the following unexpected manner. In both cases they appear to have been first ground to shape, usually spherical, oblate, or barrel-shaped, but occasionally to more elaborate forms. The beads were then hammered all over until the surface was a mass of small conchoidal fractures. It is difficult to say how this was done so evenly, but it may have been by rumbling them with other beads or small stones. After this it seems to have been frequently necessary to touch up a few parts by grinding. The beads were then perforated and finally glazed. In order to find this out, it has been necessary to examine a number of specimens, some of which have never been finished. Fig. 7 shows a place where the glaze has not flowed over, leaving a conchoidal fracture half covered up.

The difference between the two sorts of beads, which I call respectively the "high polish" and the "frosted" beads, seems to have been only the manner in which they were glazed. The frosted beads had an already made glaze put upon them and then fused, whilst the high-polished beads had an alkali only added, and the glaze was then formed by heating it until the alkali combined with the silica of the bead, and so made a glaze. The object of frosting the surface seems to have been to give a greater surface for the alkali to work on. In the case of the high-polish beads, where an alkali only has been added, the glaze seems to attach itself so firmly that it never flakes off, whilst with the frosted beads, where a complete glaze has been added, it seems to have melted at a temperature too low to attach itself properly to the quartz, and, probably due to a different coefficient of expansion, has almost always entirely flaked off and disappeared.

There is another interesting fact with reference to these beads which could only be proved by microscopic work. If the high-polish beads have taken into their surface a quantity of alkali, it must have turned the surface layer into something very similar to glass. As this is so, it is very surprising that these beads should have complete freedom from corrosion, they do not seem to devitrify more than ordinary quartz, whilst glasses of that date always show some traces of corrosion, and most of the specimens from Mesopotamia are in a hopeless state of decay.

To see if I could get a complete proof of this alteration of surface I cut a section through a fragment of a bead another part of which had been tested spectroscopically, and found to contain soda in the surface layer. When examined by ordinary light, there is no alteration near the surface that can be detected, but when polarized light is used, the difference is clearly seen, the edge becoming a different colour. The result is shown in fig. 8.

Dr. Leakey, in his most important discoveries of Early Man in Africa, found a number of small disc-like beads. They were supposed to be made of some sort of stone, different sorts being used to get the different colour. It was an important matter to settle what they were, as they are supposed

to date back to an extremely early period. I therefore cut a section. The material proved to be intensely opaque, no light coming through at all when it was 3/1000 inch thick. The section to about 1/1000 inch in thickness, and when viewed in polarized light, shows the quite unmistakable structure of ostrich shell (fig. 9). The varieties of stone therefore were proved to be either natural white ostrich shell or else ostrich shell which had been partially or completely blackened. It has been stated that the black form was blackened with iron. I very much doubt this. I think that the black material is carbon, and is produced by burning. Similar black beads to these have been found near the Nile, and recently some were discovered in Malta. A solitary specimen has been reported from Palestine, but there is no record of them from Egypt or Mesopotamia.

One material that plays a very important part in the history of beads is steatite. It is used in many ways and has several completely different treatments. These are being explained by means of the microscope. The story is much too long to give in detail here, the glazing, burning, and painting of steatite is a subject of itself, but I will select two instances. The first is in reference to the seals found in the newly discovered civilization on the Indus. One is shown in fig. 10. The extreme beauty of the modelling is evident. It is equal to the finest Greek work, but is 2000 years earlier. The actual size of the animal, from the top of his horn to his hoof, is 1⅜ inch. Now, various theories have been evolved as to how these were made. The surface of the actual seal is very brittle, and pieces about a millimetre thick frequently break away. This gave the idea that the surface was made of a steatite paste, which was moulded to shape whilst soft. The microscope showed that this was wrong. Fig. 11 is a section through part of one of these seals ×50. The horizontal straight line is the surface of the seal. The dark layer is the portion that has been affected by the treatment. Now, it is fairly obvious, from the way the crystal formation goes right through the affected layer to the surface, that the stone goes to the surface without any paste having been added, but what makes the matter quite certain is the crack. The affected layer extends for an equal distance on each side of the crack; such a result could only be obtained by either a liquid or gas penetrating in. One can now say with certainty that no paste of any sort has been added.

The second case of steatite that I will take is this.

Small beads of glazed steatite are extremely early, dating back to the Badarian period, which is before the pre-dynastic period in Egypt. Although it is impossible to give a date for this period, it is probably quite safe to say that it is not since 5000 B.C., and may be much earlier. Now, these beads are extremely well made, and are actually better glazed than the beads made in the pre-dynastic period. They are exceedingly hard—decidedly harder than glass. This hardening has evidently been caused during treatment, as steatite which has not been treated in some way is so soft that it can be scratched by the finger-nail. A microscopic section shows in fig. 12 that the glazed surface of the bead is full of crystals. These crystals proved to be of

FIG. 9

FIG. 10

FIG. 11.

FIG. 12.

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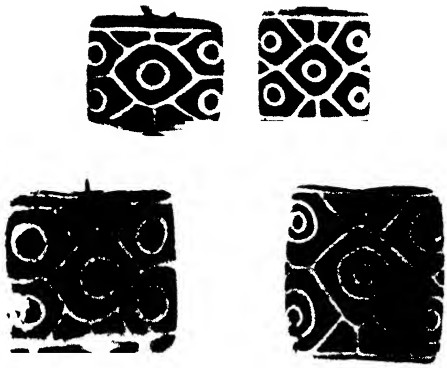


Fig 13.

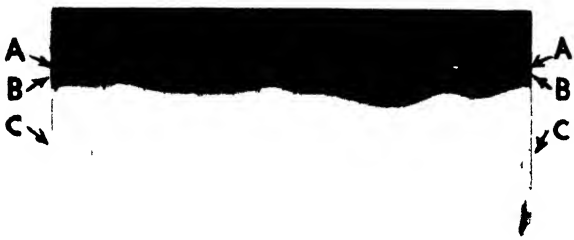


Fig. 14.

mullite, which is the material that makes porcelain so strong. But although the microscope reveals the presence of mullite crystal in the glaze, it does not show how they got there. Ordinary steatite does not contain enough alumina to account for such a mass of crystals, and it is suggested that possibly a felspatic glaze was used. If this is so, it further suggests that the knowledge of how to make porcelain may have been understood nearly seven thousand years ago.

I will give another example where the microscope has only partially solved the problem. It is connected with beads called " etched carnelians." Fig. 13 shows four specimens. They are made with a very curious technique. The pattern is made by painting the design with a solution of soda, and then firing the specimen until it is red hot. The soda bites into the surface for a considerable distance. The white lines not infrequently flake out. This has given many early archæologists the idea that the pattern was inlaid. It does not need a microscope to show that there is a great resemblance between the two beads in the upper and lower half of the figure. This is of great importance, as the top specimens came from Ur and are Sumerian work, whilst the lower ones are from Mohenjo-daro, on the Indus, and belong to the newly discovered Indus civilization. It seems quite impossible that these beads could be made without some connection between the two civilizations, which must be of approximately the same date. This is one of the chief pieces of evidence that places the Indus civilization at about 2750 B.C.

Fig 14 is a section of an etched carnelian bead. It has a magnification of 50 and is taken with polarized light, so that the black strip at the top is the background. The narrow white horizontal band is the surface of the stone, and the wavy dark line below the white band is the opaque white portion of the white line; still further below is the unaffected base of the bead. Now, the microscope shows us several things; it shows us that the colouring material of the white band is opaque, that it consists of an enormous number of tiny opaque white particles, which are distributed in layers of greater and less density as they get further from the surface. But the microscope does not explain why the front surface layer of the bead, through which all the soda must have passed, is apparently entirely unaffected.

Fig. 15 is a photo of a cylinder of clear pale-green glass, which is 1000 years earlier than any other glass of the same type. It was discovered at Tel Asmar by the Iraq Expedition of the Oriental Institute of the University of Chicago. A chip of this was examined, and showed the colouring matter as a series of small spots of pale blue. They seem to be approximately spherical, and to have a slightly different refractive index to the base.

These examples are sufficient to show some of the uses to which a microscope can be put in solving the problems connected with the science of archæology, especially those connected with that small, important, but singularly neglected branch of it which deals with the subject of beads.

DESCRIPTION OF PLATES.

Fig. 1.—Chip of cuprous oxide glass from Tel el Amarna. × 100.
Fig. 2.—Section of cuprous oxide glass made by Sir Herbert Jackson. × 100.
Fig. 3.—Chip of iron glaze: (a) metallic copper; (b) glass. × 450.
Fig. 4.—Section of black bead from Dhlo Dhlo. × 50.
Fig. 5.—Section of black glass from Zimbabwe. × 50.
Fig. 6.—Pendant of high polish quartz, showing patches not covered by glaze. × 3.
Fig. 7.—High polish quartz bead, showing conchoidal fracture partially covered by glaze. × 15.
Fig. 8.—Section of glazed quartz bead, showing the effect of glaze on altered surface. × 50.
Fig. 9.—Section of ostrich shell bead: polarized light. × 50.
Fig. 10.—Steatite seal from Harappa, on the Indus. × $1\frac{1}{3}$.
Fig. 11.—Section of seal from Mohenjo-daro: Indus civilization. × 50.
Fig. 12.—Section of small Badarian glazed quartz bead. × 50.
Fig. 13.—Etched Carnelian beads: the upper pair from Ur, Mesopotamia; the lower pair from Mohenjo-daro (Indus civilization). × $1\frac{1}{2}$.
Fig. 14.—Section of etched Carnelian bead: A. Surface of bead. B. Opaque white layer. C. Base of bead. × 50.
Fig. 15.—Cylinder of glass from Tel Asmar, Mesopotamia.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(*Under the direction of* G. M. Findlay, M.D.)

HISTOLOGICAL TECHNIQUE.

A Moist Chamber.— J. A. Reyniers ("Studies in Micrurgical Technique V. A Moist Chamber for Tissue Culture and Cellular Dissection," *Anat Rec*, 1933, **56**, 295–305). The moist chamber described involves a new application of the cross slide, floating centre principles. The chamber can be kept closed during work for considerable periods thus allowing for a minimum of change in the physical conditions within the cells. Any desired temperature or pressure of gas may be maintained. G. M. F.

A Microsuction and Injection Apparatus.—J. A. Reyniers ("Studies in Micrurgical Technique. VI A Microsuction and Injection Apparatus," *Anat. Rec.*, 1933, **56**, 307–313). In this apparatus, which may be made from laboratory odds and ends, the principle employed is the compression of an air column by a regulated stream of mercury. The air compression can be increased as slowly as desired and instantly returned to normal by a check valve, thus effecting an immediate and absolute control of the suction or injection G. M F

Pinacyanol as a Histological Stain.— F Proescher (*Proc. Soc. Exp. Biol. and Med.*, 1933, **31**, 79–81). Pinacyanol is a dye belonging to the cyanine group, manufactured by the Eastman Kodak Co, Rochester, N Y. Tissues should be fixed in formol or formol-Muller and should be cut preferably by the freezing method. The dye is made up as an 0·1–0·5 p c solution in absolute ethyl or methyl alcohol. In glass stoppered bottles protected from the light the solution keeps indefinitely. Mounted sections are flooded for from 5 to 10 seconds, transferred to distilled water for about 15 seconds, remounted and embedded in glycerine Chromatin is dark blue to cobalt violet, cytoplasm various shades of purple, connective tissue eosin-red, elastic tissue deep black-violet and muscle bluish-violet to purple. Neutrophil and eosinophil granules are unstained as are hæmoglobin and neutral fats. Various lipoids are deep bluish-violet to deep purple: amyloid carmine-red, hæmosiderin brilliant orange-yellow. Staining seems to be intensified by glycerine. G. M. F.

Phenols as Fixing Fluids.—A. Petrunkevitch ("New Fixing Fluids for General Purposes," *Science*, 1933, **77**, 117–8). Phenol gives considerable elasticity to the tissues; paranitrophenol has a slightly less marked action but is stable. Cupric-phenol fixing fluid is made from Stock Solution A: distilled water 100 c.c., nitric acid (c. p., sp. gr. 1·41–1·42) 12 c.c., $Cu(NO_3)_2.3H_2O$ 8 gr.; and Stock Solution B: 80 p.c. alcohol 100 c.c., phenol crystals c. p. 4 gm., ether 6 c.c. The stock

solutions are both stable, for use take 1 part solution A and 3 parts solution B. The mixture only keeps a few hours and therefore fixation must not continue for more than 48 hours, 12–24 hours usually being sufficient. Wash in 70 p.c alcohol. Cupric paranitrophenol fixing fluid · 60 p.c. alcohol 100 c c., nitric acid (as above) 3 c c, ether 5 c.c., cupric nitrate (as above) 2 gm., paranitrophenol c. p. crystals 5 gm. Duration of fixation is not limited by time except that penetration occurs at the rate of 0·5 mm per hour, the solutions are stable. Wash in 70 p c. alcohol In place of 5 gm of paranitrophenol, fixing fluids may contain 0·5 gm. of orthonitrophenol, α(2 . 4) dinitrophenol, β(2 : 6) dinitrophenol; picric acid (2 : 4 · 6 . trinitrophenol) Fixation and washing are as with paranitrophenol but the last two require longer washing and leave the tissues yellow. G. M. F.

Ferric Chloride Hæmatoxylin.—G Häggquist ("Eisenchloridhämatoxylin," *Ztschr. Wis. Mikr.*, 1933, **50**, 77–82). Fixatives containing mercuric chloride are preferred, especially a 20 p.c solution of formalin saturated with mercuric chloride at room temperature (not more than a month old). Sections are treated with 70 p.c. alcohol containing iodine and then with a 0·25 p c solution of sodium thiosulphate to remove the iodine Rinse in distilled water and mordant in ferric chloride, for the progressive method use a 3–5 p c solution for from 5 to 30 minutes, rinse and stain in freshly prepared hæmatoxylin, for the regressive method use a 5 p.c. solution for 1 hour Stain in 1 p.c. fresh hæmatoxylin for at least 1 hour; rinse and differentiate in 1–3 p.c. ferric chloride. The staining is blue and not black as with Heidenhain's hæmatoxylin and differentiation is easier than with iron alum. Muscle and gland are especially well stained by this method. G. M. F.

Standardization of the Endo Medium.—H. J. Conn and M. A. Darrow ("Can the Endo Medium be Standardized? " *Stain Technol*, 1934, **9**, 61–70) An investigation of various formulæ for the Endo medium has been made, using about twenty different samples of basic fuchsin Some samples of basic fuchsin were unsatisfactory with one formula, others with another. By a slight modification of the standard formula of the American Public Health Association, using 1 ml. of a 1 p c basic fuchsin solution instead of 0·5 ml. of a 10 p c. solution, every sample of basic fuchsin was satisfactory. With this modification the ratio of sulphite to fuchsin in the finished medium is 12·5 to 1 instead of roughly 3 to 1. G. M F

Mallory's Phloxine-Methylene-Blue Stain and Differentiation in Clove Oil.—L. A. Margolena ("Oil of Cloves for Differentiation in Mallory's Phloxine Methylene Blue Stain," *Stain Technol.*, 1934, **9**, 71) Instead of differentiating in 95 p.c alcohol containing colophonium, clove oil is used as it differentiates considerably faster and the pink colour shows brighter than when alcohol alone or alcoholic colophonium is used. Sections (fixed in Zenker) are stained according to Mallory's technique, rinsed in water, dehydrated by dropping upon them 95 p.c. alcohol, followed by absolute, after which clove oil is applied After the pink colour has returned to the sections a microscopic examination is advisable to decide whether differentiation is complete. Xylol and balsam follow. G. M. F.

A Stain for Spores.—M. A. Snyder ("A Modification of the Dorner Spore Stain," *Stain Technol.*, 1934, **9**, 71). The original method is cumbersome owing to the use of test-tubes submerged in boiling water and to the necessity of a heavy suspension of organisms. The modification is as follows: a thin film of the organisms is made on a slide; it is covered with a small piece of blotting-paper and several drops of freshly filtered Ziehl's carbol fuchsin are applied. The preparation is steamed for from 5 to 10 minutes on a hot plate, keeping the blotting-paper moist

with carbol fuchsin. It is decolorized instantaneously with 95 p.c. alcohol and washed in water. A drop of a saturated aqueous solution of nigrosin is spread evenly and thinly over the smear which is then dried quickly on the hot plate. Spores are red and other parts of the cells almost colourless. *B. megatherium*, *B. niger*, *B. cereus*, *B. mycoides* and some cultures of *B. subtilis* gave good results with this stain. G. M. F.

Molybdenum Hæmatoxylin.—M CLARA ("Über ein neues Molybdanhamatoxylin," *Ztschr. Wis. Mikr.*, 1933, **50**, 73 7). This stain may be used for connective tissue, nuclei, or as a differential stain, depending on the reaction of the water used after its application. Equal parts of a 1 p.c aqueous solution of hæmatoxylin and a 10 p.c. solution of ammonium molybdate are mixed. Molybdic acid is then added to saturation. The solution, which is bluish-violet when fresh, becomes dark red on standing and should be diluted with distilled water before use. Sections require no mordanting and are transferred to the hæmatoxylin directly from distilled water. Stain for 24 or more hours and rinse in distilled water. If overstained differentiate in picric acid and rinse in 80 and 90 p c. alcohol. Results: connective tissue wine-red to brown-red, other tissues unstained or very faintly red. If the sections are left in distilled water for several hours the connective tissue stain fades out and the nuclei show some coloration. If tap-water is used instead of distilled and especially if a trace of lithium carbonate is added the picture changes as the connective tissue stain disappears while the nuclei become blue and sharply defined. G. M. F.

Destaining after Iron Alum.—S. H. HUTNER ("Destaining Agents for Iron Alum Hematoxylin," *Stain Technol.*, 1934, **9**, 57–9). For staining the nuclei of protozoa the following technique is recommended. Mordant in 4 p c. iron ammonia alum for 1 hour, wash in running water for 15 minutes, stain in 0·5 p.c. hæmatoxylin for 1 hour then wash in water till no more stain comes out, destain in a saturated aqueous solution of picric acid, wash in water as before till no more picric acid comes out; blue by adding a drop or two of ammonia to the 75 p.c. alcohol used for dehydration. For cytoplasm hydrogen peroxide is an efficient oxidizer, after mordanting and staining for 30 minutes sections are run up to 50 p.c. alcohol, then destained in a freshly prepared mixture of 95 p c alcohol 2 parts and Merck's "Superoxol" (30 p c. H_2O_2) 1 part. G. M. F.

Concentration and Fixation of Free-Living Protozoa on Cover Glasses.—J T BALDWIN ("A Method for Concentrating and Fixing Free-Living Protozoa on Cover Glasses," *Science*, 1934, **79**, 143) A box, some 20 mm. deep, is made of mimeograph paper or some equally porous type, of a size into which a cover glass will fit closely. Smear a cover glass with egg albumen and place it face up in the box · stand the box on blotting-paper and fill it with fixative to a depth of 4 mm. An equal or less amount of water containing the protozoa is taken up by a pipette and placed in the box out of which the fluid seeps slowly to be absorbed by the blotting-paper. When only a thin film of fluid still envelops the organisms the cover glass is removed and dropped face down into a dish of fixative. Navaschin's fluid is particularly recommended for sticking the organisms to the glass. while the crystal violet, iodine stain is excellent for studying nuclear divisions. G. M. F.

A Rapid Method for Stained Frozen Sections.—A. A. THIBAUDEAU ("The Preparation and Staining of Frozen Sections," *J. Lab. and Clin. Med.*, 1933, **19**, 204–9). Sectioning, mounting, and staining can be carried out in 5 minutes, and the preparations are permanent. A large sledge microtome (Spencer No. 860) modified for a freezing chamber with 18 or 25 cm. knives is used. Formalin, 10 p.c.,

is used as a fixative, blocks being trimmed so that they are approximately 1–2 cm. square by 2–3 mm. thick. Sections are placed in 10 p.c. alcohol and stained in Harris' hæmatoxylin for from 5 to 15 seconds; rinse in distilled water till all excess of colour is removed, then transfer to ammoniated water, pass through ascending alcohols to 95 p.c. alcohol and then counterstain in absolute alcohol for 5 seconds; clear in carbol xylol, mount directly on the slide without a section lifter, blot with filter paper and mount in balsam. G. M. F.

A New Method of Staining Fats.—J. Zweibaum ("Sur un nouveau procédé de coloration des graisses," *Bull. d'Histol. appl.*, 1933, **10**, 210–3). The following solution is recommended for frozen sections and for cells grown "in vitro": 1 p.c. osmic acid, 2 parts; 1 p.c. chromic acid, 3 parts, 3 p.c. potassium bichromate, 3 parts. Fix 3–24 hours; wash for from 10 to 15 minutes or longer, depending on the time of fixation, transfer to 50 p.c. alcohol and stain in Sudan III in 70 p.c. alcohol for from 5 to 10 minutes. Wash and stain in dilute Delafield's hæmatoxylin. Wash and mount in Apathy's fluid. The smallest fat drops stand out scarlet or brown-red on a colourless cytoplasm, no fusion takes place and the preparations are permanent. Pieces of tissue require 24 hours' fixation, which renders them brittle if they contain much fat. In this case 20 p.c. formol is employed for 24 hours and sections are cut at 10μ thick. These sections are transferred to the chromosmic fixative for from 15 to 30 minutes before proceeding as in the first case.
G. M. F.

The Method of Fixation on the Glycogen of Cartilage.—E. Graubner ("Etude de l'influence des fixateurs sur le glycogène du cartilage," *Bull. d'Histol. appl.*, 1933, **10**, 214–23). Studies were made on the thyroid cartilages of cows, horses, pigs, and sheep. Formol, aqueous sublimate, Zenker's fluid and Muller's formol are suitable fixatives, but alcoholic solutions and formol saturated with glucose are detrimental. Frozen sections are preferred to embedded ones, while Best's staining method is excellent provided it is prolonged to 30 or 45 minutes.
G. M. F.

A Method of Staining Blood Films.—H. Goldie ("Notes sur la coloration du sang et de ses parasites," *Bull. Soc. Path. exot.*, 1933, **26**, 461–4). As staining reagents two solutions are employed: Manson's blue (methylene blue 1 c.c., sodium borate 3 c.c., distilled water 1000 c.c., ripen at 37° C. for 7 days) and a solution of trypaflavine-eosin (a 2 p.c. aqueous solution of trypaflavine 1 c.c., 2 p.c. aqueous eosin, 3 c.c. The precipitate formed is redissolved in 6 c.c. of 96 p.c. alcohol). Dried blood films, unfixed, are stained with diluted Manson's blue (2 drops to 1 c.c. of distilled water) for 30–35 seconds, wash rapidly in tap-water then stain for 15 seconds in trypaflavine-eosin (3 drops to 1 c.c. of distilled water). Wash in tap-water and dry in the incubator. G. M. F.

The Examination of Female Mosquitoes for Sporozoïtes.—P. J. Barraud ("A Method of Making Slide Smears from Female Anopheles, for Examination for Sporozoites of Malaria Parasites and of Preserving the Mosquitoes for Reference," *Ind. J. Med. Res.*, 1933, **21**, 451–4). With the aid of a needle gentle pressure is exerted on the thorax of the chloroformed but intact insect; the chitin of the anterior thoracic region under which are the salivary glands is thus raised. A minute incision enables a small portion of the tissues and of the coelomic liquid to be removed and examinated for sporozoites. The insect can still be preserved intact. G. M. F.

Giemsa Staining for Fæcal Protozoa.—E. S. Peregrin ("Nota previa sobre una nueva aplicacion del metodo de Giemsa para la coloracion de los protozoos fecales," *Med. de los paises calidos*, 1933, **6**, 5). To a drop of normal human serum is added with a platinum loop a small mass of fæcal matter and after emulsification a smear is made. The smear is dried in the air and fixed in methyl alcohol for from 3 to 5 minutes Coloration is carried out for 35 minutes with an aqueous solution of Giemsa, one drop per cubic cm. The drops of Giemsa are placed in a measure to which is added the necessary amount of water, without shaking. G. M. F.

A New Stain for Blood Cells.—C Kuhn ("Un nouveau colorant," *Le Sang*, 1933, **7**, 758). The results obtained are similar to those obtained with Romanowski stains, but the preparation is much simpler. To 200 c.c of an 0·5 p.c. aqueous solution of methylene blue, 15 c.c of ammoniacal copper sulphate solution are added (2 p.c. aqueous copper sulphate solution 6 c.c , 22 p c. pure ammonia 9 c.c.). At the end of 24 hours at 18°–20° C. the following solution is added, in small amounts, shaking each time : water soluble eosin 0·8 gm , distilled water 40 c.c. A precipitate is formed. The addition of the solution is stopped when a drop of the mixture placed on a white filter paper produces a rose-red ring round a blue central area Filter, washing the precipitate twice with 4 p.c. ammoniacal water. Dry in the incubator. The colouring solution is prepared by adding 0·12 gm. of the powder to 20 c.c. methyl alcohol and 10 c.c. pure glycerine. Six drops of the stain are added to 18 drops of methyl alcohol and the smears stained for from 10 to 15 minutes , wash rapidly in distilled water. G. M. F.

The Standardization of Biological Stains.—A. R. Peterson, H. J. Conn' and C. G. Melin ("Methods for the Standardization of Biological Stains. Part IV. The Triphenylmethane Derivatives," *Stain Technol* , 1934, **9**, 41–8). In this paper methods are given for determining the suitability of certain dyes of the triphenylmethane group for certification. The dyes for which methods are given are malachite green, brilliant green, light green SF yellowish, fast green FCF, basic fuchsin (rosanilin and pararosanilin), acid fuchsin, methyl violet, crystal violet, gentian violet, methyl green, and aniline blue. For each of these dyes methods are discussed under the following headings : (i) identification or qualitative examination , (ii) quantitative analysis : and (iii) biological tests. G. M. F.

Acid or Neutral Formalin for the Fixation of Nerve Tissues.—H. A. Davenport ("Acid Versus Neutral Formalin Solution as a Neurological Fixative," *Stain Technol.*, 1934, **9**, 49–52). The fixing action of 10 p.c. formalin solution alone and with formic, acetic, propionic, butyric, lactic, monochloracetic, dichloracetic or trichloracetic acid was studied by means of stains with silver, osmic acid, and cresyl violet. It was found that in general better fixation and staining was obtained with acid than without. Less difference was seen in comparing one acid with another than was previously expected. Propionic, butyric, and dichloracetic showed no promise of having practical value. Formic and monochloracetic acids as modifiers gave superior stains with osmic acid, while silver and cresyl violet stains of the same material were about equal to those made from formalin-acetic fixed material. Lactic acid caused rather more distortion of tissue elements than the others but was compatible with good staining. Acetic acid was most effective in concentrations of from 3 to 5 p.c., while the stronger acids such as formic, monochloracetic, lactic, and trichloracetic were effective in concentrations of 0·5–1 p.c. G. M. F.

A Modification of the Pal Weigert Method for Myelin.—S. L. Clark and J. W. Ward ("A Variation of the Pal-Weigert Method for Staining Myelin Sheaths,"

Stain Technol., 1934, **9**, 53–5). This variation of the Pal-Weigert method for staining myelin sheaths does not require old ripened hæmatoxylin, and can be completed in from 3 to 5 hours. It varies from the Pal-Weigert method by the insertion of a bath of ferric ammonium sulphate both before and after staining with hæmatoxylin. Sections are mordanted in a 4 p.c. aqueous solution of ferric ammonium sulphate ($FeNH_4(SO_4)_2.12H_2O$) iron alum for from 2 to 24 hours as is convenient They are then washed for a short time in tap-water. They are stained for from 1 to 2 hours in hæmatoxylin similar to that used for the Weigert method, made up by adding 9 volumes of solution A to 1 volume of solution B. (Solution A is made by adding 7 c.c. of a saturated aqueous solution of lithium carbonate to 93 c.c. of distilled water Solution B is made by dissolving 1 gm of hæmatoxylin in 10 c.c. of absolute alcohol.) Sections are next washed for 2 or 3 minutes in tap-water. They are then partially decolorized in 4 p.c. ferric ammonium sulphate solution till the gray and white matter are barely distinguishable. Sections are then washed in tap-water for 2 or 3 minutes. Next the sections are placed in a 0·25 p.c. solution of potassium permanganate, in which the gray and white matter become clearly distinguishable when the sections are held up to the light. They are coloured brown by the permanganate They are then quickly rinsed in tap-water Decolorization is continued in a freshly prepared mixture of equal parts of a 1 p c. solution of oxalic acid and a 1 p.c. solution of sodium or potassium sulphite. The gray matter is bleached till it is clear and colourless (except where it contains some myelinated fibres. Sections are again washed in tap-water for 2 or 3 minutes. They are then placed for 5 minutes or more in a saturated solution of lithium carbonate where they regain their blueness. They are thoroughly washed in tap-water and counterstained if desired, then dehydrated, cleared and mounted

G. M. F.

Cytology.

Fixed Mineral Deposits in the Seminal Tissues during Spermatogenesis.—A. Policard ("Les matières minérales fixes des éléments séminaux au cours de la spermatogénèse," *Bull. d'Histol. appl*, 1933, **10**, 313–20). As a result of micro-incineration the heads of spermatozoa are found to contain very fine yellowish ash (due to iron) in the anterior portion and in the posterior white shiny ash. The middle portion and the tail show very little mineral matter. The evolution of the mineral matter was studied during spermatogenesis in the testis of rats; ash was present in considerable amounts during the spermatogonial and spermatocyte stages, but spermatids contained very little mineral matter. A progressive increase to the spermatozoa stage followed, Sertoli's cells showed very little ash, residual bodies a considerable amount. G. M. F.

Microglia-like Cells in the Liver, Kidneys, and Spleen.—H S. Dunning and L. Stevenson ("Microglia-like Cells and their Reaction following Injury to the Liver, Spleen, and Kidney," *Amer. J. Path.*, 1934, **10**, 343–8, 4 pls.). Cells were demonstrated by del Río-Hortega's original silver carbonate method of specific staining for microglia in the liver, spleen, and kidney of the rabbit that in morphology are identical with the nearly normal or very early transitional forms of microglia in the nervous system. In their reaction to injury and to intravital staining with trypan blue they closely resemble microglia. A more advanced transitional form was found in the spleen to be a histiocyte or large mononuclear phagocyte without processes but containing droplets of fat, granules of trypan blue, blood pigment and engulfed lymphocytes. G. M. F.

The Appearance of Nissl Granules in Relation to the Fixative.—Y. Shibata ("Vergleichende Beobachtung mit der Fixierungsweise der verschiedenen Fixierungsmittel, besonders unter Berucksichtigung ihrer Wasserstoffionen-konzentration an den Nissl-Körperchen der Ganglienzellen," *Folia Anat. Japonica.*, 1933, **11**, 275–84). The appearance of Nissl granules when stained with toluidine blue depends on the physiological condition and also on the fixatives used, and the reaction of the latter. Spinal cord of the rabbit and dog served as material after fixation in absolute alcohol, Zenker's fluid, 10 p c formalin, Hamilton's, Orth's, and Rath's fixatives. Tissues after fixatives containing potassium bichromate show a diffuse blue staining of the plasma or irregular granulations and stained nuclear granules. Luna's and Muller's fixatives hinder the staining while alcohol, formol, and sublimate bring out Nissl bodies and glial nuclei clearly. When 10 p c. formalin is used with phosphate buffers the *p*H remains constant before and after fixation; the more alkaline the fixing fluid the more intense the colour when basic stains are used. The most suitable reaction for Nissl bodies is about *p*H 5·3.

G. M. F.

Grass-Hopper Eggs and Paraffin Embedding.—E H Slifer and R. L. King ("Grasshopper Eggs and the Paraffin Method," *Science*, 1933, **78**, 366). Grasshopper eggs, which have hitherto been difficult to fix and embed in paraffin, were satisfactorily fixed by Petrunkevitch's cupric-phenol fixing fluid, but for testis and embryo this fixative was most unsatisfactory. The following method was found satisfactory. Material was fixed in Carnoy-Lebrun's fixative (*cf.* J. W. McNabb, *J. Morph. and Physiol*, 1928, **45**, 47), wash in iodized alcohol, cut in half and store the micropyle halves in 70–80 p c. alcohol till required. Treat with 4 p.c phenol in 80 p c. alcohol for 24 hours, dehydrate in 95 p c alcohol, clear in carbol xylol, infiltrate and cut with the cut end out. Trim the paraffin away until the yoke is just exposed and soak in water for from 24 to 48 hours. As an alternative after dehydration in 95 p c. alcohol, it may be cleared in aniline oil, washed in chloroform, embedded and then placed in water as above. G. M. F.

Differential Staining of Living and Dead Bacteria.—F. P. Gay and A. R. Clark ("The Differentiation of Living from Dead Bacteria by Staining Reactions," *J Bact.*, 1934, **27**, 175–89). In the Proca-Kayser technique for differentiating living from dead bacteria a bacterial smear which has been fixed by drying and flaming is stained for 3–5 minutes in Loeffler's alkaline methylene blue, followed by rapid washing and staining for 5–10 seconds only in Ziehl-Neelsen's carbol fuchsin with subsequent washing. If the time indicated is followed carefully in each case, the method is supposed to stain living bacteria blue and dead bacteria purple to red. The accuracy of the method has been confirmed, apparent exceptions on careful study only serving as further confirmation. Spores, however, do not behave like vegetative cells, as dead spores stain blue and living spores very faintly if at all. Carbol fuchsin can be replaced by aqueous basic fuchsin or safranin or with less satisfactory results by Bismarck brown or alcoholic eosin. Loeffler's methylene blue may be replaced by saturated aqueous methylene blue. The effect of neutral red on bacteria before and after ingestion by phagocytes was investigated; dye did not stain the bacteria till they were ingested. G. M. F.

Pigment Cells in Fishes.—G. M. Smith ("The Formation of Melaniridosomes in Healing Wounds of Hæmulidæ," *Quart. J. Micr. Soc.*, 1934, **76**, 647–54, 4 text-figs.). A description is given of the formation of a simple type of chromatic organ or melaniridosome occurring during the healing of experimental wounds in two species of grunt (*Bathystoma aurolineatum* and *Hæmulon sciurus*). Newly

formed melanophores and iridocytes in the substance of the wound become attracted to each other and group themselves into permanent masses known as chromatic organs or melaniridosomes. Chromatic organs of this type were observed in later stages of wound healing (6–10 days) when epithelialization and formation of the new corium were well advanced. G. M. F.

Oogenesis in Sciurus palmarum.—R. Clement ("On the Cytoplasmic Inclusions in the Oogenesis of *Sciurus palmarum*," *Allahabad Univ. Studies*, 1934, **10**, 347–75, 2 pls.). Golgi bodies appear in a juxta-nuclear manner in young oocytes both in fixed preparations and vital staining experiments In the earlier stages they appear to form a network which later breaks up and is dispersed in the cytoplasm. Infiltration of Golgi bodies takes place from the follicular epithelium to the egg. Mitochondria in the earlier stages are concentrated in the yolk nucleus of the Balbiani area; they take no part in vitellogenesis. Nucleolar extrusions occur but also take no part in vitellogenesis. Vacuome is present and is stained by neutral red; it is distinct from Golgi apparatus which is not stained by this dye. G. M. F.

Golgi Apparatus in the Heart Muscle of Certain Mammals.—A. Merland ("Appareil de Golgi de la fibre musculaire cardiaque chez quelques mammifères," *Compt. rend. Soc de Biol.*, 1934, **115**, 1647–8). As revealed by the Da Fano technique, the Golgi apparatus in the heart muscle of the horse and sheep is made up of a mass of eight to twelve large vacuoles lying in the axial sacoplasma at the two ends of the nucleus. These vacuoles only are impregnated to the exclusion of all other structures in the cardiac fibre. The apparatus of Cajal-Fusari is made up of mitochondria. In the rabbit and guinea-pig the Golgi vacuoles are situated not only at the poles of the nucleus but all round it. G. M. F.

Golgi Apparatus in the Thyroid of Amphibians.—E. Uhlenhuth ("The Golgi Apparatus in the Thyroid Gland of Amphibians, in its Relation to Excretion Polarity," *Quart. J. Micr. Soc.*, 1934, **76**, 615–43, 1 pl.). In the adult Californian newt, *Triturus torosus*, the Golgi apparatus appears to consist of two components, one which is deeply blackened and another which stains much darker than the cytoplasm and corresponds to Bowen's idiosomatic substance. The former frequently forms a shell round the latter. In the resting condition of the cell the Golgi apparatus is relatively small and compressed in an apico-basal direction. In preparation for colloid release through the basal cell ends the Golgi apparatus enlarges greatly in an apico-basal direction and its trabeculæ become stout. In the cells in which fluid has accumulated in large lacunæ and is excreted through the basal cell-ends the Golgi apparatus becomes fragmented into long slender pieces. In the cells in which basal secretion has ceased the fragments are transformed into short, thick, lumpy pieces. When the colloid droplets are redissolved and transformed into vacuoles the Golgi bodies appear as black rings round a dark core. In only a few instances is there a close relationship between the Golgi apparatus and the secretion products. In no case does the Golgi apparatus show a reversal of its position from the apex to the base of the cell. Its position does not show the excretion polarity of the cell. G. M. F.

The Harderian Gland of the Rat.—E. S. Duthie ("Studies on the Cytology of the Harderian Gland of the Rat," *Quart. J. Micr. Soc.*, 1934, **76**, 549–58, 9 text-figs.). In the Harderian gland of the rat the secretory granules are formed inside vacuoles which may be selectively stained by Janus green B and neutral red. A comparison of the fresh and fixed preparations makes it probable that the Golgi

bodies are in every case applied to the surface of the perigranular vacuole throughout the development of the enclosed granule. A scheme for granule development in this gland is advanced. G. M. F.

Vital Staining of Stenostomum.—J. S. Carter ("Reactions of Stenostomum to Vital Staining," *J. Exp. Zool.*, 1933, **65**, 159–79). The animals were placed in a ring of vaseline on a slide with a very thin cover glass applied and studied under water immersion. A small amount of the vital dyes accumulated in the vacuoles but much more in the rhabdites. All the stains encountered an acid medium in the rhabdites, but in their diffusion into the animal body the reaction of the medium became more and more alkaline. Benzene-azo-alpha-naphthalamine coloured intensely and rapidly, the rhabdites in the epidermis being red, in the mesenchyme orange, and in the enteron yellow. Bismarck brown stained rhabdites in the epidermis orange-red, in the mesenchyme yellow-orange, and in the enteron yellow. Unlike the other stains it caused the rhabdites to break up into spherules before the epidermal cells were removed from the epithelium. Alizarin remained yellow in the rhabdites but much deeper in the enteron. It caused accumulation of dark blue concrements in the distended anterior end of the main stem of nephridial tubules. Trypan blue failed to stain. Vital staining did not inhibit growth, fission or gonad formation. G. M. F.

Arthropoda.

Mites from Eastern Siberia.—Iwan Sokolow ("Beiträge zur Kenntnis der Hydracarinenfauna des Ussuri-Gebietes. II. Hydracarinen der fliessenden Gewasser," *Zoologische Jahrbücher* (Abt. f. *Syst. Ökol u. Geogr. der Tiere*), 1934, **65**, H3/4, 309 88, 96 text-figs.). This is a continuation of a communication, referred to in this Journal LIII—155, wherein the hydracarine fauna of the still waters east of the Amur and Ussuri Rivers was dealt with. The present communication deals with the river fauna of that area. Fifty species are recorded of which over twenty are new species or new varieties. In addition one species is added to the lake fauna. About one dozen of the new names are each represented by only one specimen while the others are better established, either from the number of localities where found or the greater number of specimens taken. A concluding note deals with the geographic features of the collections and very briefly summarizes the results of collections made by other members of the expedition.

BM/HNDH

Dutch Watermites.—A. J. Besseling ("Nederlandsche Hydrachnidæ," *Entomologische Berichten*, 1934, no. 196, Deel IX, 20–4). A list of Hydracarina taken in Holland with localities in each case. Notes *Hygrobates squamifer* Sig Thor, *H. amphilaminatus* Lundbl., and *H. falcilaminatus* Walter as synonyms of *H. longiporus* Sig Thor. BM/HNDH

Variation in Megapus nodipalpis.—A. J. Besseling ("Nederlandsche Hydrachnidæ—De variabiliteit van Megapus nodipalpis S. Thor," *Entomologische Berichten*, 1933, no. 193, Deel VIII, 516–20). Discusses the variability which he has encountered in this species. BM/HNDH

New Records for Watermites.—K. Viets ("Kleine Sammlungen in- und auslandischer Wassermilben," *Zoologischer Anzeiger*, 1933, **104**, 261–74, 10 figs.). Besides furnishing the descriptions of three new species of Hydracarids, viz. *Lebertia* (L.) *brigantina, Limnesia coxalis, Polyatax japonensis*, and one new halacarid

Rhombognathus (sens. str.) *spinipes*, the author records a number of small collections from localities: (1) within Germany, and (2) from other countries, viz. Austria, Russia, Bulgaria, and Italy, while the new Limnesia comes from Kenya in East Africa. *Hygrobates naicus* Johnst. is set aside in favour of Thor's identification of this species with *H fluviatilis* (Ström), 1768. Some other names are dropped in favour of earlier workers whose descriptive work leaves much to be desired. *Polyatax* is a new subgenus stated to stand near *Atax*, *Pentatax*, and *Unionicola*, but the Author does not state to which genus it should be attached. Viets proposes certain nomenclative changes. *Forelia variegator* (Koch's. *Arr. v.*) for *Forelia parmata* Koen., *Teutonia cometes* (Koch's *Hygrobates c.*) for *Teutonia primaria* Koen., *Arrenurus præacutus* as nymph of *Arr. cyanipes* and *Hygrobates squamifer* as synonym for *H. longiporus*. BM/HNDH

Uruguayan Watermites.—K. VIETS ("Wassermilben aus Uruguay," *Zoologischer Anzeiger*, 1933, **104**, 84–90, 9 text-figs). In addition to some *Eylaids*, which though not fully agreeing with the typical forms, Viets refers to *E. perincisa* Ribo. and *E. protendens* Berl. and some *Hydrachna* and *Limnesia* nymphs not dealt with for want of mature forms to insure correct identification, two new species of *Arrhenurus* are described. As Viets has reverted to the older form rejected by some writers as an incorrect derivation from the Greek, he describes them as *Arrenurus* (*Mega.*) *thomseni* and *A.* (*Mega.*) *gibberifer*. The collection was made in a lake near Montevideo by R. Thomsen BM/HNDH

More Mites from Underground Waters.—Based on material collected by Dr. S. Karaman in Jugoslavia, three reports are submitted by VIETS ("Fünfte Mitteilung über Wassermilben aus unterirdischen Gewässern (Hydrachnellæ und Halacaridæ)," *Zoologischer Anzeiger*, 1934, **105**, 133–41, 12 text-figs) Apart from details of the previously unknown nymph of *Megapus subterraneus* Viets, the chief feature so far as concerns Hydrachnellæ is the erection of a new subfamily Tartarothyasinæ (Fam. Thyasidæ) to embrace a new genus *Tartarothyas* with *micrommata* n sp. as its genotype. A new fresh-water halacarid (Nympha II) is also recorded as *Limnohalacarus stygohalacarus scupiensis* n. subgen., n. sp An identification table for the Limnohalacarinæ facilitates work on the genera. The second communication ("Sechste Mitteilung über Wassermilben aus unterirdischen Gewässern" *Ibid.*, 1934, **105**, 273–81, 9 text-figs.) describes *Acherontacarus fonticolus* as a new species and also an unknown larval form provisionally placed in the same genus. The third contribution ("Siebente Mitteilung uber Wassermilben aus unterirdischen Gewassern," *Ibid.*, 1934, **106**, 118–24, 12 text-figs.) describes the teleiophan stage of *Tartarothyas micrommata* and the male of *Stygohalacarus scupiensis*. *Cerberothrombium* is a new subgenus to *Stygothrombium* with *armatum* n. sp. as its type species. BM/HNDH

On Species of Eylais.—L. SZALAY ("Über einige Eylais-arten (Hydracarina)," *Annales Musei Nationalis Hungarici*, 1934, XXVIII, 271–7, 2 text-figs.). Following a description of *Eylais mülleri mrazeki* Thon, Author discusses the relation of a number of Eylaid species to one another. Some are grouped under *Eylais sens. str.* and others under a new subgenus which he names *Pareylais*. A number of names are reduced to synonyms, while an identification by Daday as *E. mülleri* is renamed *Eylais* (*E.*) *extendens* var. *monofissa*, nov. nom. The distinctive character of the maxillary organ of *E. hamata* is the reason for creating a new subgenus *Meteylais* to cover the species and its allied forms. BM/HNDH

Protozoa

Antarctic Foraminifera.—A. S. Warthin, Jr. ("Foraminifera from the Ross Sea," *Amer. Mus. Novit*, 1934, no. 721, 1–4, text-figs. 1–5). A sounding of grey mud from 280 fathoms in the Bay of Whales, Ross Sea, in 78° 34′ S, 163° 48′ W., is stated to be the most southerly point at which Foraminifera have been collected. The locality is about 90 miles from the nearest land. About 350 identifiable specimens of Foraminifera were obtained, representing thirty-six species of nineteen different genera, nearly all having arenaceous or agglutinate tests. The hyaline (calcareous) forms were represented by only twenty-four specimens of six species and four different genera, and the porcellanous group is entirely absent. Two new species are described and figured, *Trochammina rossensis* and *Cyclammina gouldi*, the latter being a somewhat abnormal type of its genus in having a weakly agglutinate test. The author comments on the paucity of calcareous specimens as compared with those found in *Terra Nova* material from the Ross Sea Nearly half of the calcareous specimens were "distorted or otherwise atypical" It is stated, as an instance, that "*Cibicides* cf *refulgens* Montfort, develops in the later chambers an imperforate, *porcellanous* wall with a chitinous lining" (Abstractor's italics). Such a statement, entirely at variance with all recorded observations on a common species of worldwide distribution, would appear to demand more than casual mention. The description *porcellanous*, as applied to the shell material of the Miliolids, has been a recognized term for nearly a century, and should not be loosely used. There is no known instance of a combination of "porcellanous" and "hyaline" structure in any genus, and if the condition described by the author is confirmed, there is no doubt that "these differences would be sufficient to remove the Bay of Whales forms not only from the genus but even the family in which they are normally placed." A. E.

Types of Cretaceous Buliminæ.—J. A. Cushman and F. L. Parker ("Notes on Some of the Earlier Species Originally Described as *Bulimina*," *Cont. Cush. Lab For Res*, 1934, no. 142, 27–36, pl V, and figs. 1–9 on pl. VI). Most of the species described up to the year 1890 are studied in connection with the original types, or where these are not available from material obtained from the original locality. The original figures of Reuss are often too small to be recognizable, but there are at least three collections in existence which were named by him when he was publishing his work on the Bohemian Cretaceous strata, all of which have been examined. The various species are assigned to several genera—*Bulimina*, *Buliminella*, *Arenobulimina*, *Ataxophragmium*, etc., and the paper, which should be of great value to workers, is well illustrated. A. E.

The Genus Spiroplectoides.—J. A. Cushman ("Notes on the Genus *Spiroplectoides* and its Species," *Cont. Cush. Lab. For. Res.*, 1934, no. 143, 37–44, figs. 10–28 on pl. VI). Figures and describes seven species, none new, which the author attributes to his genus *Spiroplectoides*, 1927, and gives lists of their recorded localities in the American Cretaceous. *Spiroplectoides* has for its genotype *Spiroplecta rosula* Ehrenberg, which is "completely calcareous and distinctly perforate" and leaves "no residue when dissolved in acid." Some of the species referred to in the paper are "apparently siliceous and are not affected by acid." They cannot therefore belong to the genus *Spiroplectoides*, and are indeed usually referred by authors to *Spiroplectammina* Cushman, 1927. Incidentally there is no mention of *Bolivinopsis* Yakovlev, 1891, which appears to be identical with *Spiroplectoides*, and therefore has priority over that genus. (*See* W. A. Macfadyen in *J. Roy. Micr. Soc.*, 1933, **53**, pp. 139–41.) A. E.

Cornuspira or Ammodiscus?—J. A. CUSHMAN ("The Generic Position of *Cornuspira cretacea* Reuss," *Cont. Cush Lab. For Res.*, 1934, no. 144, 44–7). *Cornuspira cretacea* has been a recognized cretaceous fossil ever since it was first recorded by Reuss from the Bohemian Chalk in 1845, under the name *Operculina cretacea*. Reuss transferred his species to the porcellanous genus *Cornuspira* in 1860. The examination of a series of specimens from various European localities, including Hamm, Westphalia, the deposit on which Reuss changed the generic name of his species, has convinced the author that the species should be transferred to *Ammodiscus* Reuss, 1861. The test is resistant to treatment with acid, and its wall is found to be built up of "very fine fragmentary material with a predominance of cement." The position cannot be regarded as definitely settled until the original Bohemian types, or specimens from Bohemian material, have been subjected to the same tests, but on the evidence produced it seems probable that this well-known fossil is a true *Ammodiscus*. A. E.

Bibliography of Foraminifera.—HANS E. THALMANN ("Bibliography of the Foraminifera for the Year 1931," *J. Palæont.*, 1933, **7**, 343–9). With Sherborn's well-known bibliography of the literature 1565–1888, Beutler's continuation to 1910, and Liebus from 1911–30, the student now has a means of reference to the literature of the past, though many publications have escaped the notice of the last two editors. Herr Thalmann will attempt the very desirable task of keeping information more nearly up-to-date by the issue of a yearly list. That under notice contains the titles of 145 papers published in 1931. The author appeals for the co-operation of workers, especially in the form of communications regarding papers published by local societies and institutions which are not to be found in the great libraries. A. E.

New Foraminifera.—HANS E. THALMANN ("Index to Genera and Species of Foraminifera erected during the Year 1931," *J Palæont*, 1933, **7**, 350–5). Supplementing the bibliography of the literature for 1931 previously referred to, the author gives a list of eleven new genera and 194 new species described in that literature. A E.

Two New Names.—HANS E. THALMANN ("Zwei neue Vertreter der Foraminiferen-Gattung *Rotalia* Lamarck, 1804; *R cubana* nom. nov. und *R. trispinosa* nom. nov.," *Eclog. geol. Helvet.*, 1933, **26**, no. 2, 248–51, pl. 12) The pretty little form figured by d'Orbigny in 1839 from Cuba under the name *Calcarina pulchella* was identified as a *Rotalia* by Parker and Jones, so long ago as 1865. As d'Orbigny had already named a different organism *Rotalia pulchella* in 1826, the second name must lapse, and the Cuban form should henceforth be known as *Rotalia cubana* Thalmann. Brady in his Challenger monograph figured under the name *Rotalia pulchella* (d'Orbigny), a form which is of common occurrence in the Malay Archipelago. Though allied to the Cuban species it is specifically distinct, and the Malay form is accordingly renamed *Rotalia trispinosa* Thalmann. A. E.

Florida Eocene.—W. STORRS COLE and GERALD M. PONTON ("New Species of *Fabularia*, *Asterocyclina* and *Lepidocyclina* from the Florida Eocene," *Amer. Midland Naturalist*, 1934, **15**, no. 2, 138–47, pls. 1–2). *Fabularia vaughani*, discovered in association with numerous small Foraminifera and many Orbitoids, in an Eocene limestone, is of great interest as the first record of the genus in America. *Fabularia* is very distinctive in its structure and has hitherto been known only from Eocene strata in France and Egypt, and Miocene of Australia; but the authors anticipate that other American records will be found when more detailed work is done on the Eocene strata of the Caribbean regions. A. E.

Australian Tertiary.—F. CHAPMAN, W. J. PARR, and A. C. COLLINS ("Tertiary Foraminifera of Victoria, Australia—The Balcombian Deposits of Port Phillip, Part III," *J Linn. Soc. Lond.*, 1934, **38**, Zool. 553–77, pls. 8–11). The first part of this paper was published so long ago as 1907, and the second in 1926. The delay in the issue of this third (but not final) instalment is stated to be due to the necessity of reconsidering the scheme of classification, in view of the publication of Cushman's scheme in 1928, and its fundamental differences from the classification of Brady, used for the first two parts of the paper. As a result the authors have followed a course which is usually deprecated, and have changed horses while still in mid-stream. An outline of a fresh scheme of classification which they propose to publish is prefixed to the paper, but only so far as it affects the previous publications Its publication in full must be awaited before it can be judged on its merits. The present instalment deals principally with genera formerly assigned to the Rotaliidæ, but now divided among several new families Six new species and two new varieties are described The plates drawn by the junior author are very good. It is of great interest to notice that a considerable proportion of the species have survived and are still to be found living round the Australian coasts.

A. E.

A Siliceous Foraminifer.—G. DEFLANDRE ("Sur un foraminifère siliceux fossile des diatomites miocènes de Californie · *Silicotextulina diatomitarum* n.g., n.sp," *C. R. Ac. Sci. Paris*, **198**, no. 16, 1934, 1446–8). The author has found an organism in diatomites from several well-known Californian deposits, including Santa Monica and Redondo, which he describes as "constructed on the plan of *Textularia* (or *Gümbelina*), the spherical protoculum is followed by two rows of alternate chambers, carrying more or less tubular perforations confined to the outer portion." Specimens are found not only in the raw material but also in the residue after treatment with acid, thus proving their entirely siliceous character. The author gives reasons which satisfy him that the test has not become silicified during fossilization, but represents an organism which had a naturally siliceous or perhaps chitino-siliceous test This is announced as preliminary to a report which it is intended to publish and which will deal with the evolution of siliceous forms. In the meantime the name is apparently *nomen nudum*, there being no illustration or adequate definition of either genus or species.

A. E.

New Flagellate of Ducks—G. G KIMURA ("*Cochlosoma rostratum* sp. nov., an Intestinal Flagellate of Domesticated Ducks," *Trans. Amer. Micr. Soc.*, **53**, 1934, 102, 1 pl., 1 text-fig.). Description of a new flagellate, *Cochlosoma rostratum* sp.n. (Protomonadida), from the large intestine of the domesticated ducks, *Anas platyrhynchus* and *Cairina moschata*, in California. The neuromotor apparatus of this parasite consists of six flagella (four postero-lateral and two trailing), four blepharoplasts, an axostyle, a chromatic basal rod, and a parabasal. Its dimensions are $6{\cdot}1\text{–}10{\cdot}0 \times 3{\cdot}9\text{–}6{\cdot}7\mu$.

C. A. H.

Histomonas Infection in Poultry.—E. E. TYZZER ("Studies on Histomoniasis, or 'Blackhead' Infection, in the Chicken and the Turkey," *Proc. Amer. Acad Arts and Sci.*, 1934, **69**, 189–264, 6 pls.) "Blackhead" is a disease of turkeys and chickens caused by a flagellate, *Histomonas meleagridis*. In turkeys the disease is usually fatal, while in chickens it is mild and of short duration, the bird becoming a "carrier" and disseminating the parasite through its discharges. The flagellate also infects *Heterakis gallinæ*, the common cæcal worm of poultry, and new hosts are infected by ingestion of the embryonated eggs of this worm. The present paper describes in great detail the results of experimental histomoniasis in young

turkeys and chickens The disease can be produced by feeding of materials containing *Histomonas* to young birds, and by rectal injection of such materials. Contaminated soil is also a source of infection, its infectivity being due to the presence of the eggs of *Heterakis*. The flagellate has no resistant stage, and exposure of the discharges and diseased tissues to 1·5 p.c. nitric acid renders them non-infective. *Histomonas* has been cultivated in the following medium: Agar 14 gm, NaCl 6 gm, and KH_2PO_4 2·7 gm. are dissolved in 900 c.c. tap-water by heating in the autoclave. The agar is cooled to 55° C., the beaten white of one egg diluted with a small amount of water is added, and the mixture is cooked in the Arnold sterilizer for 45 minutes, being shaken thrice during the process. After the coagulated egg white settles, the agar is filtered through cotton, adjusted to *p*H 7·2, passed through filter-paper, tubed, autoclaved, and stored The required number of test-tubes are heated in boiling water, slanted, and a small amount of sterilized rice starch is added to each tube Normal saline containing 5 p.c. sterile horse serum is then added to cover the slants The forms of *Histomonas* developing in culture are similar to those occurring in the fæcal discharges. The flagellate remains virulent after eleven months, but loses its pathogenicity after twenty-three months The attenuated strain has been used successfully as a vaccine against a fully virulent strain. C. A. H

Coccidia of Mustelidæ.—(1) W L. Yakimoff and W. F. Gousseff ("Coccidia of Martens and Sables," *J. Parasit.*, 1934, **20**, 251–2, 1 fig.). (2) A. A. Kingscote ("*Eimeria mustelæ*, n sp. from *Mustela vison*," *ibid.*, 252–3) (1) Record of coccidia from the marten (*Martes martes*) and the sable (*M. zibelina*), both identical with *Eimeria sibirica* previously described from the sable. (2) The name *Eimeria mustelæ* sp.n. is given to a new coccidium of the mink (*Mustela vison*) characterized by ovoid oocysts devoid of a micropyle and measuring 17·0–22·1×9·0–18·0μ. Sporocystic residue constantly present, small residual body only in some oocysts. C. A H.

Infection of Monkeys with Human Trichomonad.—R. Hegner ("Infections of the Vagina of Rhesus Monkeys with *Trichomonas hominis* from Man," *J. Parasit*, 1934, **20**, 247–8). The human intestinal flagellate, *Trichomonas hominis*, was inoculated into the vagina of a number of monkeys, *Macacus rhesus*, where it survived for a period of at least twenty days. It appeared that the human parasite was incapable of establishing itself permanently in the monkey. C. A. H.

Life-History of Trypanosoma cruzi.—E. Dias ("Estudos sobre o *Schizotrypanum cruzi*," *Mem Inst. Osw. Cruz*, 1934, **28**, 1–110, 12 pls.). Although *Trypanosoma cruzi*, the causative agent of human trypanosomiasis or Chagas' disease in South Africa, was first described twenty-five years ago and has been studied by many observers ever since, a number of questions regarding its life-cycle and transmission have not yet been fully elucidated. According to Chagas and his followers, *T. cruzi* in the course of its development in the gut of the intermediate host, *Triatoma megista* (Reduviidæ), produces the infective forms in the salivary glands and the infection is transmitted to the vertebrate host by the inoculative method, through the bite of the bug. Brumpt has shown, however, that the final stages of development of *T. cruzi* take place in the hind gut of the bug, and the transmission is contaminative through the fæces deposited on the mucous membrane. Though the correctness of Brumpt's conclusions was accepted by most authorities, the alleged successful infection of animals through the bite of the bug gave some support to Chagas' hypothesis, and the possibility of the inoculative transmission was admitted as an alternative method. In the

present work the author has undertaken a complete revision of the life-cycle of *T. cruzi*. While his results confirm the more generally accepted interpretation of the development and method of transmission of this trypanosome, the particular value of this work lies in the numerous original experiments and in a critical analysis of previous data. It has been established beyond all doubt that infection of the vertebrate takes place exclusively by contamination of the mucous membranes or of the intact skin with the droppings of the bug containing the infective stages of the trypanosome. On the other hand, numerous attempts to obtain infection through the bite of infected bugs invariably produced negative results. Moreover, Dias failed to find any flagellates in the salivary glands of infected *Triatoma*. As regards the claims of successful infection through the bite, this was undoubtedly due to the survival of unaltered blood trypanosomes in the stomach of the bug which were shown to be capable of producing infection. The results obtained thus fully corroborate Brumpt's original observations, which can now be regarded as firmly established, to the exclusion of Chagas' hypothesis One part of the paper is devoted to the development of *T. cruzi* in the vertebrate host This proceeds along familiar lines, but special emphasis is given to the histotropism of this parasite and its particular predilection for the cellular elements of the reticulo-endothelial system. [It should be noted that throughout the paper the author refers to the parasite as *Schizotrypanum cruzi*, a misnomer rejected long ago by its creator (Chagas, 1911) in favour of the original name, *Trypanosoma cruzi* Chagas, 1909, which should be retained as the only valid one.] C. A. H.

Ultramicroscopic Viruses.

Central Nervous System in Equine Encephalomyelitis.—O. Larsell, C. M Haring, and K. F. Meyer ("Histologial Changes in the Central Nervous System following Equine Encephalomyelitis," *Amer J. Path*, 1934, **10**, 361–74, 2 pls.). The most constant feature of the brain and spinal cords of horses, guinea-pigs, and man subjected to the virus of equine encephalomyelitis was perivascular infiltration. Suggestions of intranuclear inclusions were found in some of the nerve cells in certain animals but this feature was too inconstant to permit of their being considered as characteristic features of the affected cells. Loss of Nissl substance, necrosis and neuronophagia were all present in both animals and man. Cytoplasmic inclusions were noted in many nerve cells in animals affected by the virus and in a human brain. Similar inclusions were also found in smaller numbers in three horses that died from an unknown sepsis and also in a normal horse 12 years of age.. The number of cytoplasmic inclusions in the nerve cells of the virus-infected animals was greater than in the control animals and appeared to be increased by the pathological conditions of the disease. G. M. F.

Supersonic Waves and Vaccinia Virus.—H. Yaoi and W. Kakahara ("Effect of Short Exposure to Supersonic Waves on Vaccinia Virus and Some Bacteria," *Jap. J. Exp. Med.*, 1934, **12**, 131–5). Hopwood (*J. Sc. Instruments*, 1929, **6**, 34) had shown that vaccinia virus not only survives exposure to supersonic waves but is increased in activity. These results were confirmed, but using purified vaccinia virus complete inactivation was produced by exposure for 2 minutes to supersonic waves of 530,000 cycles per second caused by a quartz oscillator acting in a basin of mineral oil. G. M. F.

The Significance of Intranuclear Inclusions in Whooping Cough.—H. A. McCordock and M. G. Smith ("Intranuclear Inclusions: Incidence and

Possible Significance in Whooping Cough and in a Variety of other Conditions." *Amer. J. Diseases Child.*, 1934, **47**, 771-9, 4 text-figs.). In a group of sixty cases of children not suffering from whooping cough, intranuclear inclusions were found six times in the salivary glands and only once in other organs. In three cases which showed chronic pneumonia with peribronchial mononuclear cellular infiltration there was also fibrosis of the pancreas. The relationship of the intranuclear inclusions to the ætiology of whooping cough is discussed. G. M. F.

The in Vitro Cultivation of Newcastle Disease of Fowls.—T. TOPACIO ("Cultivation of Avian-Pest Virus (Newcastle Disease) in Tissue Culture," *Philippine J. Sc*, 1934, **53**, 245–52). The virus of Newcastle disease was cultivated in a medium of chick-embryo tissue and plasma for thirty-one generations. Culture virus was able to immunize against natural virus and tolerated a considerable degree of bacterial contamination. Beyond a nuclear pyknosis of the epithelial cells no intracellular change of significance was noted in growing tissue cells in the presence of active virus. G. M. F.

BOTANY.

(*Under the direction of* A. B. RENDLE, M.A., D.Sc., F.R.S.)

Cytology.

Sex Chromosomes in Plants.—CECIL YAMPOLSKY ("Sex and Chromosomes in Plants," *Bull. Torrey Bot. Club*, 1933, **60**, 639–55). The large array of sex forms in the phanerogamic flora cannot be explained merely by the postulation of sex chromosomes. The purport of this discourse may be summarized in the author's words: "As long as we shall ascribe to chromosomes the importance in heredity that we do, we shall see in chromosomal behaviour all that we expect to see."

J. S.

Translocation of Chromosomes in Datura.—A. D. BERGNER and A. F. BLAKESLEE ("Cytology of a Translocation of the 1·2 Chromosome in *Datura*," *Bull. Torrey Bot. Club*, 1934, **61**, 197–209). Simple translocations are one of the kinds of chromosomal change caused by radiation treatment. The first of this type of change found in *Datura* involved the 1·2 which is the largest chromosome. As a result of radiation there was produced a gamete in which this 1·2 chromosome was broken in the mid-region. The paper describes the detailed cytology of the resultant translocation and that of the six cytologically distinguishable types of off-spring. J. S.

Meiotic Chromosomes of Sorghum.—C. L. HUSKINS and S. G. SMITH ("A Cytological Study of the Genus *Sorghum* Pers.," *J. Genetics*, 1934, **28**, 387–95). In the "tetraploid" *S. halepense* (2n = 40) there are commonly from ten to fourteen bivalents, the remainder of the chromosomes being associated in quadrivalents, sexivalents or octavalents. In the "diploid" forms of *Sorghum* examined (2n = 20) ten bivalents are usually found, but quadrivalents are common and sexivalents occur occasionally. A fragmentally tetrasomic plant of *S. verticilliflorum* was found which was phenotypically normal. A strain of Dakota Amber Sorgo was found to be partially asynaptic, but the multivalents much more common than in any other variety. Points of genetic interest are discussed. J. S.

Chromosome Number in the Magnoliales.—THOMAS W. WHITAKER ("Chromosome Number and Relationship in the Magnoliales," *J. Arn. Arbor.*, 1933, **14**, 376–85). In the Magnoliales thus far investigated there is evidence that there are two lines of cytological development. The following genera occur in one group: *Magnolia*, *Liriodendron*, *Cercidiphyllum*, *Drimys*, *Trochodendron*, and *Tetracentron*. In these the basic chromosome number is 19. The chromosomes are characteristically small, short rods. In the other group are *Illicium*, *Schisandra*, *Kadsura*, and *Euptelea* with a basic number of fourteen chromosomes which are much larger than those of the first group. A table is given comparing chromosome number, type of nodal anatomy and other anatomical features in the genera investigated. Some of the more recent systems of classification of the Magnoliales are criticized and certain revisions suggested which would bring about a more natural system of classification. J. S.

Cytology of a Tetraploid Œnothera.—B. M. Davis ("The Genetics and Cytology of a Tetraploid from *Œnothera franciscana* Bartlett," *Genetics*, 1933, **18**, 293–323). An autotetraploid of *Œnothera franciscana* Bartlett arose by way of a triploid in the F_2 of the cross *franciscana* × *franciscana sulfurea nana*. The F_1 of the cross were all like *franciscana*. The F_2 gave the expected yellow talls and dwarfs, sulphur talls and dwarfs. Among the yellow talls were four "hero" plants, one of which was proved to be triploid with twenty-one chromosomes. This is considered to have arisen from a 7-chromosome gamete uniting with a 14-chromosome gamete resulting from suppression of the second division. In the progeny of the selfed triploid one plant was proved to be tetraploid with twenty-eight chromosomes. This is said to have arisen through the union of two 14-chromosome gametes, and consequently carries four sets of *franciscana* chromosomes. It has bred remarkably true through four generations. The pollen and seeds of the original parents, the triploid and tetraploid, are compared. Meiosis is described in detail for the triploid and tetraploid. Irregularities are common and account for the low percentage of good pollen in these plants. J. S.

Chromosome Division and Pairing in Fritillaria.—C. L. Huskins and S. G. Smith ("Chromosome Division and Pairing in *Fritillaria Meleagris*: The Mechanism of Meiosis," *J. Genetics*, 1934, **28**, 397–406). *Fritillaria Meleagris* has chiasmata almost exclusively localized in the region of the attachment constriction. At earliest leptotene segments of the chromosomes are found to be split. At zygotene pairing occurs only along the unsplit segments. The secondary split of pachytene occurs in the paired segments, while the split halves of the unpaired segments become more widely separated. Pairing was never found complete throughout the length of any chromosome pair. The observations are discussed in relation to the observations of others on *Orthoptera* with localized chromosome pairing and to hypotheses on the mechanism of meiosis. The essence of the "mitosis-meiosis hypothesis" of the authors is that at *all* stages of both mitosis and meiosis chromomeres have an attraction in pairs and a repulsion between pairs of pairs. The observations on which this is based are enumerated. J. S

Fixation by Aldehydes.—Conway Zirkle ("Aldehydes as Cytological Fixatives," *Protoplasma*, 1933, **20**, 169–79). Root-tips of *Zea Mays* were fixed (*a*) in formic, acetic, propionic, and butyric aldehyde, formamide and trichloracetic aldehyde; (*b*) in each aldehyde combined with acetic acid, formic acid, copper propionate, copper lactate, Muller's fixative, copper bichromate, chromic sulphate, and picric acid. Formaldehyde gave a basic image with nucleoli, nuclear lymph, hyaloplasm and mitochondria fixed, resting chromatin and spindle fibres dissolved. The other aldehydes gave the acid image with chromatin, plastin, spindle-fibres, and spongioplasm fixed, nuclear lymph and mitochondria dissolved. Any mixture containing acetic or formic acid or copper propionate gave an acid image, these substances penetrating more quickly than the aldehydes. With copper lactate all aldehydes gave acid images except formaldehyde, and similar results were obtained in mixtures with Müller's fixative, copper bichromate, chromic sulphate and picric acid with certain exceptions regarding the mitochondria. The existence of two types of aldehyde fixation is discussed. J. S.

Dicarboxylic Acids in Fixing Fluids.—Conway Zirkle ("Some Dicarboxylic Acids as Components of Fixing Fluids," *Protoplasma*, 1933, **19**, 565–77). The acids here investigated can be arranged in two series: (*a*) Oxalic, malonic, succinic, glutaric; (*b*) succinic, malic, tartaric. Root-tips of *Zea Mays* were fixed (*a*) in these acids with and without formaldehyde; (*b*) in sodium oxalate and sodium

tetroxalate with and without formaldehyde; (*c*) in the ammonium-, copper- and nickel-acid salts of each of the other acids together with the copper- and nickel-ammonium salts; and (*d*) in mixtures of each of these salts with formaldehyde. Certain other mixtures were also tested. With the exception of oxalic, each acid and acid salt gave the typical acid image, i.e. chromatin, plastin, spindle fibres, and spongioplasm were fixed, nuclear lymph, mitochondria, and hyaloplasm dissolved. Oxalic fixed a number of heavily staining granules which appear to be mitochondrial bodies. When mixed with formaldehyde these acids and salts give the typical basic fixation image of formaldehyde. This indicates that formaldehyde penetrates the tissue before the acids or acid salts. The fixing properties of the dicarboxylic acids are thus unlike those of the fatty acids. The fixation images of the other mixtures are described, and the paper illustrated with seven microphotographs.

J. S.

Fixative for Smears.—K. Yasui ("Ethyl Alcohol as a Fixative for Smear Materials," *Cytologia*, 1933, **5**, 140–5). Pollen mother-cells of *Fritillaria verticillata* var. *Thunbergii, Lilium Henryi*, and *Tradescantia* were used for this investigation. The somatic tissue of *Drosophila melanogaster* was also observed. Ethyl alcohol fixation (75–100 p.c.) gave excellent results with smears for the study of general chromosome morphology and was found suitable for staining with various dyes especially for Feulgen's nucleal method. J. S.

Cyto-Genetical Studies on Soy Beans.—Y. Fukuda ("Cyto-Genetica Studies on the Wild and Cultivated Manchurian Soy Beans (*Glycine* L.)," *Jap. J. Bot.*, 1933, **6**, 489–506). The species studied are *Glycine hispida* Max., *G. gracilis* Skvortzow, and *G. Soja* S. & Z. In all these the diploid chromosome number is 40, the haploid 20. The development of the pollen grains is regular and similar in the three species, also the morphology of the chromosomes and size of the mature grains. In evolutionary series the species may be placed in the order *G. Soja*, *G. gracilis*, *G. hispida* which is the same order as that of the weights of the seeds of plants belonging to the different species. The origin of the soy beans is discussed.

J. S.

Asynaptic Dwarf Oats and Wheat.—C. L. Huskins and E. M. Hearne ("Meiosis in Asynaptic Dwarf Oats and Wheat," *J. Roy. Micr. Soc.*, 1933, **53**, 109–17). Asynapsis is produced in certain dwarf wheats and oats through the loss of a specific pair of chromosomes (the "C" chromosomes). The lack of pairing is correlated with premature splitting of the chromosome threads and irregular contraction. The observations are discussed with respect to recent hypotheses correlating meiosis and mitosis. The paper gives in detail the important prophase stages, and is illustrated by thirty figures. The possible bearing of the irregularities in splitting and contraction on the significance of similar irregularities in mammalian tumours is briefly discussed. J. S.

Chromosome Numbers in the Madinæ.— D. A. Johansen ("Cytology of the Tribe Madinæ, Family Compositæ," *Bot. Gaz*, 1933, **95**, 177–208). The paper is preliminary to a final monograph on the Madinæ and lists the n and $2n$ chromosome numbers for a large number of species with brief descriptions of chromosome morphology and behaviour. One hundred and four figures accompany the text.

J. S.

Amines in Fixing Fluids.—Conway Zirkle ("Amines in Cytological Fixing Fluids," *Protoplasma*, 1934, **20**, 473–82). The amines investigated were formamide, ethylene diamine, di-methyl, and tri-methyl amine, ethyl, di-ethyl and tri-ethyl

amine, pyridine and di-iso-amyl amine. Root-tips of *Zea Mays* were used as material. With the exception of formamide, the amines were too basic to fix the material by themselves and were therefore investigated when mixed with other reagents. Amines plus chromic acid gave the basic fixation image at *p*H 5·0–6·0. Mitochondria were fixed by each mixture more especially by those containing the most fat-soluble amines. Amines plus chromic and acetic acids gave the acid fixation image set by the rapidly penetrating acetic. Other mixtures used were with copper bichromate and a modification of Erliki's fluid. The addition of the amines improves the fixation of mitochondria. Every mixture which contained formamide gave an acid fixation image regardless of the *p*H of the solution. J. S.

Asiatic and New World Cotton Hybrids.—A. Skovsted ("Cytological Studies in Cotton. II. Two Interspecific Hybrids between Asiatic and New-World Cottons," *J. Genetics*, 1934, **28**, 407–24). The hybrids studied were (1) *G. barbadense* L. × *G. arboreum* L., (2) (*G. arboreum* L. × *G. herbaceum* L.) F_1 × [(*G hirsutum* L. × *G. barbadense* L) × *G. barbadense* L.] selfed. The first hybrid was slightly fertile with 2n = 39, while the other was sterile and had 2n = 52 A diploid egg from Asiatic cotton probably functioned to produce the 52-chromosome form. The somatic chromosomes of all Asiatic cottons are of equal size and relatively large, those of the New World cottons are of two sizes, thirteen relatively large and thirteen small. This distinction is maintained in the hybrids. In the first meiotic division at least thirteen univalents are present in both hybrids, and the form with fifty-two chromosomes shows the same chromosome conjugation as the triploid Asiatic cotton (Skovsted, 1933) but with the addition of an extra set of thirteen non-homologous chromosomes. It is concluded that the New World cottons are allopolyploid species, probably originating from a cross between two species of *Gossypium* both with n = 13 but with morphologically dissimilar and non-homologous sets of chromosomes. One of the parental species was probably an Asiatic cotton or closely allied type, while the other was probably a New World species characterized by its smaller chromosomes. J. S.

Diploid and Triploid Asiatic Cotton.—A. Skovsted ("Cytological Studies in Cotton. I. The Mitosis and the Meiosis in Diploid and Triploid Asiatic Cotton," *Ann. Bot.*, 1933, **47**, 227–51). A brief review is given of previous papers on the cytology of the cottons. The technique developed specially for cotton and suitable for work in the tropics is described in detail. Study was made of a triploid Asiatic cotton which appeared as a sterile rogue in culture. This is compounded of thirteen chromosomes from the female and twenty-six chromosomes from the male parent. Somatic mitosis is described for the diploid *G. arboreum* and the triploid. Only one nucleolus is seen in each nucleus during resting and prophase stages in root-tips of diploid and triploid tissue. Meiosis is described in detail for the diploid *G. arboreum*, the interspecific hybrid *G. herbaceum* × *G. arboreum* and the triploid. Irregularities occur in the first division in the diploid hybrid leading to the appearance of chromosome plates with twelve and fourteen chromosomes. The first metaphase in the triploid shows a mixture of uni-, bi-, tri- and multivalent chromosomes. The conjugations demonstrate that auto-syndesis between the chromosomes in a set of thirteen must take place. This is probably the result of the Asiatic cottons (n = 13) being polyploids. The second division is regular and shows that a distribution of all the chromosomes to two poles at first division must take place in about 95 p.c. of cases. Rare irregularities are the formation of three nuclei, the fusion of the two chromosome plates, which would result in the formation of pollen grains with thirty-nine chromosomes. The possibility of producing tetraploid cotton

is referred to Chromosome counts from 200 second metaphases show that the distribution of chromosomes in triploid Asiatic cotton differs from that in triploid *Datura* and *Solanum*. Irregular distribution from the polyvalents may explain this. The paper is illustrated by 113 figures. J. S.

Anatomy and Morphology.

Anatomical Differences between Grewia and Microcos.—M. M. CHATTAWAY ("Anatomical Evidence that *Grewia* and *Microcos* are Distinct Genera," *Trop. Woods*, 1934, **38**, 9–11). Differences in the structure of the wood of certain species of *Grewia* lend support to the view that this genus should be subdivided by reviving the genus *Microcos*. The anatomical differences affect the rays, the parenchyma, and the vessels. B. J. R.

Wood Structure of the Flacourtiaceæ.—W. W. TUPPER ("Preliminary Report on the Wood Structure of the Flacourtiaceæ," *Trop. Woods*, 1934, **38**, 11–14). As considerable difficulty has arisen in determining the exact limits of the Flacourtiaceæ, the author has undertaken a study of the wood structure of the group, in the hope that it may prove of value in establishing the relationship of its members The anatomy of all the woods hitherto examined has been found to be remarkably constant and similar, with two exceptions. The most characteristic feature is the rays, which are narrow and inconspicuous but are remarkably heterogeneous. Frequently the rays are vertically confluent, thus forming exceedingly high thin sheets of ray tissue. Growth rings are not usually evident. The woods are all diffuse-porous, the pores being small and evenly distributed. The vessel members have characteristically simple perforations, but *Taraktogenos*, *Hydnocarpus*, *Scottellia*, and *Hasseltia* have exclusively scalariform perforation plates, or at least predominantly of this type, while other genera, such as *Osmelia*, have occasional scalariform perforations with the simple type predominant. Wood-parenchyma is generally lacking, when it does occur, as in *Lætia* and *Pangium*, it is scanty and paratracheal, although a single genus, *Paropsia*, has been described as having abundant diffuse wood parenchyma The wood-fibres have thick lateral walls and are generally septate. The only two exceptions to the characteristic wood structure of the Flacourtiaceæ come from the island of Mauritius and lack herbarium vouchers. These are labelled *Aphloia mauritiana* Bak. and *Erythrospermum amplifolium* Thou. B. J. R.

Wood Structure of the Malvaceæ.—IRMA E. WEBBER ("Systematic Anatomy of the Woods of the Malvaceæ," *Trop. Woods*, 1934, **38**, 15–36, 5 pls.). The more important systems of classification of the Malvaceæ are summarized and an annotated list of genera of the family is given. Structural features of the woods hitherto unreported for the family or at variance with previous reports include (*a*) the occurrence of vertical gum ducts of traumatic origin in *Urena lobata*; (*b*) gossypol cavities of sporadic occurrence in the xylem rays of *Gossypium mexicanum*, *G. Morrilli*, *G. peruvianum*, and *G. Schottii*; (*c*) broader rays than previously reported for the family; and (*d*) macroscopic ripple marks in *Kydia*, *Tetrasida*, *Hoheria*, *Shantzia*, *Montezuma*, *Dicellostyles*, and *Julostylis*. There is considerable variation between individual wood specimens of some of the species. Differences between woods of certain genera are less marked than between species of some of the others. The woods show evidences of specialization which indicate that the Malvaceæ are fairly advanced in the phylogenetic scale. B. J. R.

Estimating the Age of Transplants and Seedlings.—L. CHALK (" Annual Rings in Transplants and Seedlings," *Quart. J. For.*, 1934, **28**, (3), 220–4, 3 pls.). The author describes a method of estimating the age of the seedlings and transplants by the use of photomicrographs. The method also helps to determine the year in which transplanting took place, which is a matter of importance in forestry practice. It is suggested that under normal conditions the successive annual rings of a vigorous seedling should be wider than the preceding one, at least for three or four years, so that a ring which is no wider than the one before may represent a check of some description. A sudden reduction in ring width is an indication of transplanting, but under favourable conditions the latter operation may be carried out without any serious check to the normal growth. B. J. R.

Anatomy of the genus Calligonum L.—R. LEMESLE (" Etude anatomique du Genre *Calligonum* L," *Ann. Sci. Nat.* (*Bot.*), 1934, **16**, 5–62, 5 pls., 11 figs.). The anatomy of the stems of eighteen species of *Calligonum* is described in detail. Three anatomical peculiarities are noteworthy: (1) The existence beneath the epidermis of fibrous strands the cell-walls of which are differentiated into two layers: an external mucilaginous layer and a much thicker internal cellulose layer; (2) The constant presence of supernumerary vascular bundles arranged in semi-circles round the cortical fibrous strands, (3) The existence of two kinds of water-conducting tracheids: the one attached to the spiral vessels of the supernumerary bundles, the other independent of the conducting elements and arising through the modification of parenchymatous cells of the colourless cortical zone. A. W. E.

Stipules and Sheath.—A. PONZO (" Stipule e Guaina," *Nuov. Giorn. Bot. Ital.*, 1934, **41**, 1-24). The primitive Angiosperm is considered to have had simple, verticillate, hexamerous leaves. From this arose, by fusion, a type with opposite leaves, and by more intimate fusion a single phyllode with a sheath surrounding the entire node, as in the Monocotyledons. Stipules are of primary and secondary origin. The four lateral phyllodes of the primitive hexamerous type are transformed into stipules, giving a type with opposite, stipulate leaves, the stipules being independent of the leaves to which they belong. Otherwise the six leaves of the verticel may fuse in two groups of three, giving two opposite leaves with an enlarged leaf-base, which resolves itself into two lateral stipules and true leaf. The alternate-leaved type is derived from this by displacement from the common node, each leaf retaining the leaf-base structure, resolving into stipules and leaf. These stipules are also of primary type. Stipules of secondary type are those of cortical origin, pseudostipules; metastipules; stipular laciniæ of the sheath. The axillary stipule arises from the fusion of lateral stipules or else by the proliferation of adaxial tissue of the leaf, like the ligule. In all cases these are not relic structures but more recent formations arising through the need to protect the bud. The leaf-skin theory of Miss Saunders should receive consideration since it would aid considerably in the study of stipules. A. W. E.

Stem Structure in Grasses of Semi-Arid Region.—R. H. CANFIELD (" Stem Structure of Grasses on the Jornada Experimental Range," *Bot. Gaz.*, 1934, **95**, 636–48, 8 figs.). Grasses growing in the Jornada Experimental Range, a semi-arid region near Las Cruces, New Mexico, were examined anatomically; 74 p.c. of them were found to have solid stems. Forage contained 85 p.c. or more of solid stemmed grasses. Grasses with hollow stems grew either in more favourable locations or completed their growth during a few weeks of damp conditions. Hollow-stemmed grasses are unable to withstand long dry periods. It

is suggested that the solid stem is an index to be used in selecting grasses for introduction into semi-arid regions. F. B.

Phloem Anatomy and Graft Unions in Nicotiana.—A. S. Crafts ("Phloem Anatomy in Two Species of *Nicotiana*, with Notes on the Interspecific Graft Union," *Bot. Gaz.*, 1934, **95**, 592–608, 9 figs., 2 pls.). The development of phloem elements in *Nicotiana tabacum* differs little from that described for the potato. Primary sieve tubes contain nuclei, slime-bodies, plastids and the usual cytoplasmic structures. Neutral red accumulation and protoplasmic streaming decreases with age. Secondary sieve-tubes have no slime-bodies and at an early stage may have four nuclei. Later on, they acquire the usual properties of mature sieve-tubes Phloem ontogeny in *N. glauca* is very similar. In interspecific grafts of *N. tabacum* and *N. glauca* vascular strands derived from callus parenchyma connect stock and scion within as few as five days after grafting. Orientation of cambium initials depends on matching of original vascular strands. Conduction may be hindered in a rough graft. Secondary sieve-tubes apparently are adapted to the function of conduction at certain stages in their ontogeny. F. B.

Vascular Ontogeny in the Soy Bean.—Willis H. Bell ("Ontogeny of the Primary Axis of *Soja max*," *Bot. Gaz.*, 1934, **95**, 622-35, 37 figs.). The variety used in the investigations was the commercial Mammoth Yellow. The root is developed according to Janczewski's "fourth angiospermous type" and at maturity is a tetrarch radial protostele. Root-stem transition is low. The cotyledons are photosynthetic but drop early. Leaf-traces consist of three bundles The stem consists of an endarch collateral dictyostele, pericycle, cortex, and epidermis. The dictyostele consists of the common bundles of the leaf-traces. Vessel segments usually have annular and spiral thickening of protoxylem, but sometimes a few pitted metaxylem vessels can be observed. A large part of the primary xylem later matures as connective tissue. The pericycle external to the bundles differentiates as fibres except in the region of the medullary rays where it remains parenchymatous. F. B.

Ovule and Embryo-Sac of Plumbago capensis.—Arthur W. Haupt ("Ovule and Embryo-Sac of *Plumbago capensis*," *Bot. Gaz.*, 1934, **95**, 649-59, 28 figs.). The single ovule of *Plumbago capensis* is strictly cauline in origin. The ovule curves through a complete circle bringing the micropyle to the upward position. Two integuments are present, the outer one not developing on the side facing the funicle The archesporial cell gives rise to a primary parietal cell and a megaspore mother-cell. Two layers of parietal tissue are finally produced. The megaspore mother-cell develops directly into the embryo-sac. An eight-nucleate embryo-sac is formed with the daughter nuclei remaining together in pairs. From one of the micropylar pair the egg is organized. Of the remaining seven nuclei, three usually degenerate, while four soon fuse. The mature embryo-sac consists of a large egg, and a primary endosperm nucleus formed by fusion of the four polar nuclei. F. B.

CRYPTOGAMIA.

Pteridophyta.

Bothrodendron.—Mary G. Calder ("Notes on the Kidston Collection of Fossil Plant Slides. No. II. The Anatomy of the Axis of *Bothrodendron mundum* Williamson sp.," *Trans. Roy. Soc. Edinb.*, 1934, **57**, part III, 665–73, 1 pl., 2 figs.).

Some new features of the anatomy of the axis of *Bothrodendron mundum* are discussed and figured. The pith cells vary in different specimens from thin to very thick walls, and are elongated but not prosenchymatous; in the thick-walled condition there are invariably one to two layers of thin-walled pith-cells adjoining the inner surface of the xylem. Occasionally there are marked perforations in the xylem ring; apparently they are not related to the size of the stem. The middle cortex where preserved is of "hyphal" structure with a marked system of lacunæ. In the outer region of the outer cortex, and just within the phelloderm where this tissue is present, a ring of "cortical tracheidal strands" is found in some specimens, but no connection of these strands with the outer surface of the stem or with the leaf-traces has been found. A small-sized type of stem, with comparatively narrow middle cortex and small parichnos in the leaf-traces in the outer cortex, and with outer cortical cells markedly thick-walled throughout, is tentatively described as the peduncle of the cone. A. G.

Vessels in Selaginella.—H. DUERDEN ("On the Occurrence of Vessels in *Selaginella*," *Ann. Bot.*, 1934, **48**, 459–65, 1 pl.). Investigation shows that in *Selaginella oregana*, *S. rupestris*, *S. eremophila*, *S. densa*, *S. Underwoodi*, *S. arizonica*, *S. Hanseni*, and *S. Bigelowii*, which are all homophyllous species, the xylem consists mostly of vessels, though some pointed tracheids also occur. In *S. rupincola*, which is also homophyllous, true vessels are rarely present, the xylem being mostly composed of pointed tracheids, with some round-ended tracheids. In the homophyllous *S. spinosa* the xylem is entirely tracheidal. As to the heterophyllous species, the xylem is also entirely tracheidal, for example in *S. chrysorhizos*, *S. chrysocaulos*, *S. pallidissima*, *S. Victoriæ*, *S. grandis*. A. G.

Selaginella.—A. H. G. ALSTON ("Notes on *Selaginella*. V. The Selaginellæ of Trinidad and Tobago," *J. Bot.*, 1934, **72**, 33–40, 1 pl.). A list of twelve species of *Selaginella* from Trinidad and Tobago, with synonymy, references and distribution. The distinctive specific characters are embodied in a key. A. G.

Lycopodium Spores.—L. R. WILSON ("The Spores of the Genus *Lycopodium* in the United States and Canada," *Rhodora*, 1934, **36**, 13–9, 3 pls.). Camera lucida drawings of typical spores of ten species of *Lycopodium* are given in pairs, showing the basal and the apical views of each spore. The characters are discussed, and a synoptic key is provided based upon spore relationship and gross morphology. A. G.

Lycopodium Selago.—S. WILLIAMS ("A Contribution to the Experimental Morphology of *Lycopodium Selago*, with Special Reference to the Development of Adventitious Shoots," *Trans. Roy. Soc. Edin.*, 1934, **57**, part III, 711–37, 3 pls., 12 figs.). The structure of young plants derived from bulbils is described, as also are the effects of decapitation of such young plants (*a*) immediately behind the growing point, (*b*) at a slightly lower level, (*c*) at more than 3 mm. behind the apex. The resultant regeneration differs in character in the three cases, and is described. Adventitious developments take place more rapidly from young tissues than from older; such developments are favoured by relatively high temperatures and a constantly humid atmosphere. The partial separation of leaves from the parent stem results in the production of adventitious buds at the base of the adaxial surface. Regeneration from detached bulbil leaves is described. The morphology of the normal bulbils is discussed; the bulbil is a transformed leaf-rudiment. A comparison is made between the primary cell-masses formed during the develop-

ment of the epidermal types of regeneration with similar stages in the adventitious developments of *L. ramulosum* and *Phylloglossum* and with the hemispherical protuberances of *Rhynia Gwynne-Vaughani*. A. G.

Camptosorus.—Ilda McVeigh ("Vegetative Reproduction in *Camptosorus rhizophyllus*," *Bot. Gaz.*, 1934, **95**, 503–510, 8 figs.). An investigation of the origin of the new plants formed by *Camptosorus rhizophyllus*. These arise in the embryonic region of the leaf-tip. The first leaf of the new plant is formed by the continued growth of the apical cell of the parent leaf. The stem arises from cells in the embryonic part of the leaf-tip, probably from one of the segments of the apical cell of the parent leaf The roots originate probably in two ways, from cells in the embryonic region of the leaf-tip and from cells of the procambial strand. Thus, as in most ferns, the adventitious structures originate either in undifferentiated or in slightly differentiated cells. A. G.

Bryophyta.

Sphærocarpos.—Margaret B. Siler ("Development of Spore-Walls in *Sphærocarpos Donnellii*," *Bot. Gaz.*, 1934, **95**, 563–91, 26 figs.). The spores of *Sphærocarpos* are usually liberated in persistent tetrads; but in some plants the spores of a tetrad separate. In both cases the spore-mother-cell develops in the same way, dividing to form young spore-tetrads enclosed by a thin mother-cell-wall. In a persistent tetrad a gelatinous special wall, composed of hemispherical masses with depressions between, develops around the tetrad and later is extended as a thin layer between the spores; whereas in a separable tetrad the hemispherical masses of special wall develop also over the inner faces of the spores. In each case there is deposited about each spore a darkly staining first spore-wall with ridges corresponding to the depressions in the special wall, and a thick intine. The special wall in either case becomes differentiated into a lamellate layer. In the persistent tetrad the lamellate layer is thick over the dorsal faces of the spores, where it develops a prominent tubercle, and is thin and irregular between spores, holding the tetrad together. In the separable tetrad, on the other hand, the lamellate layer surrounds each spore on all faces, with a much less prominent dorsal protuberance. Thus the original distribution of the special wall material determines whether the spores will remain united or will become separable at maturity. A. G.

Acromastigum.—Alexander W. Evans ("A Revision of the Genus *Acromastigum*," *Ann. Bryologici*, 1934, Supplementary Volume III, 1–178, 40 figs.). The genus *Acromastigum* was founded by the author in 1900 (*Bull. Torrey Bot. Club*, **27**, 103), and is unique among hepatics as comprising plants with terminal branching from both lateral and ventral segments. A new generic definition is given in the present monograph, and twenty-eight species are defined and discussed. The type is *Mastigobryum* (?) *integrifolium* Austin, and the genus comprises in great part section B of *Mastigobryum* in the *Synopsis Hepaticarum* of Gottsche, Lindenberg and Nees, 1845. Keys to the four groups of species are provided. Five new species are described; and chapters are devoted to the histology, phylogeny, and distribution of the genus. A. G.

Foot in Mosses.—Nellie M. Blaikley ("The Structure of the Foot in certain Mosses and in *Anthoceros lævis*," *Trans. Roy. Soc. Edin.*, 1934, **57**, part III, 699–709, 10 figs.). The structure of the foot of the sporogonium has been investigated in about sixty species of British mosses and is described for six species repre-

sentative of the main groups of mosses *Rhacomitrium fasciculare, Fissidens bryoides, Bryum capillare, Andreæa petrophila,* and *Diphyscium foliosum,* also for *Anthoceros lævis.* In the Eu-Bryales the structure is sufficiently uniform, save for a deviation in *Bryum* itself. Distinctive features are found in the foot of Sphagnales, Andreæales, Polytrichales and Buxbaumiales. The foot-structure in *Anthoceros* resembles that in *Tmesipteris.* A. G.

Polytrichum.—J. H. Albrecht ("Synopsis of the European species of *Pogonatum* and *Polytrichum,*" *J. Bot.*, 1934, **72**, 75–80; 104–10, 2 figs.). The European species and subspecies of *Polytrichum,* in which is included *Pogonatum,* are arranged in natural groups and described. A key is provided in which the distinguishing characters are drawn from the leaves, especially from the leaf-margin, and from the lamellæ and their free border. One group, including *P. juniperinum* and *P. piliferum* is separated by a little known character, the areolation of the broadly inflexed elamellate margin of the lamina. A. G.

Grimmia.—Hjalmar Möller ("Lövmossornas utbredning i Sverige. XII. Grimmiaceæ 2. *Grimmia,*" *Arkiv for Botanik*, 1934, **26**A, Häfte 2, no. 2, 1–138, 7 pls., 29 figs., and 28 map diagrams). Critical notes on the twenty species of *Grimmia* found in Sweden, with figures of leaf-form and structure, synonymy, literature and distribution. A. G.

Bryological Notes.—H. N. Dixon ("Miscellanea Bryologica. XII," *J. Bot.*, 1934, **72**, 12–8). (1) Some Japanese species of *Ulota* are discussed; the confusion connected with *U. nipponensis* Besch. is cleared up; the species is a good one, but its original description was faulty. *U. crispa* is recorded for three localities in Japan. *U. japonica* appears to be a distinct species, but the type specimen needs to be studied. (2) *Byssophora Duthiei,* a Mussoorie moss distributed by Dr. E. Levier, is a form, largely protonemal, of *Anœctangium Stracheyanum* Mitt. (3) *Clastobryum tenuirameum* is a new combination for the Indian moss *Stereodon tenuirameus* Mitt., which has been partly confused with a Javanese moss, *Clastobryella tenella* Fleisch. (4) Hooker's *Musci Exotici:* the dates of publication of the fascicles of the two volumes are given, so far as can be ascertained. (5) An index is given to the notes published by the author in his series of papers entitled *Miscellanea Bryologica,* which have appeared in the *Journal of Botany* during the past twenty years. A. G.

Irish Bryophyta.—Eleonora Armitage ("Bryophyta new to Co. Waterford," *J. Bot.*, 1934, **72**, 18–20). Some species and varieties of *Sphagnum,* eighteen mosses and eight hepatics, collected at various places in the county of Waterford and not previously recorded in its flora. A. G.

Central American Mosses.—Edwin B. Bartram ("Mosses of Southern British Honduras and Guatemala," *Rhodora*, 1934, **36**, 55–8, 1 fig.). Lists of fourteen mosses from British Honduras and nine from Guatemala; among the latter is *Pilotrichum spiculiferum,* a new species which is described and figured. A. G.

Hawaiian Mosses.—Edwin B. Bartram ("Manual of Hawaiian Mosses," *Bernice P. Bishop Museum, Honolulu,* 1933, Bulletin 101, 1–275, 195 figs.). Descriptions of 198 species and twenty-six varieties of Hawaiian mosses illustrated by text-figures drawn from authentic material. Keys to the genera and species are provided. About half the species are endemic. Sixteen species and four varieties are new to science. (Confer *Rhodora,* 1934, **36**, 132.) A. G.

Thallophyta.

Algæ.

Californian Diatoms.—W. E. ALLEN (" Marine Plantation Diatoms of Lower California," *Bot. Gaz.*, 1934, **95**, 485–92). A report on the abundance of plankton diatoms in surface waters off the coast of Lower California from Pt. San Eugenio to Pt. San Lazaro, a distance of over 100 miles. The greatest abundance was found off Pt. Abreojos. The number of genera observed in the plankton was twenty-nine ; and the genera and species were found to be essentially similar to those of the Californian coast to the north. A. G.

Nostochopsis.—YÂJÑAVALKYA BHÂRADWÂJA (" A New Species of *Nostochopsis* (*Nostochopsis radians* sp. nov.)," *New Phyt*, 1934, **33**, 1–7, 2 figs.). Description o the habit and structure of a new blue-green alga from a stream near the Jog Falls in the State of Mysore, India. It resembles *Nostochopsis* in its attached mode of growth, the radial arrangement of the filaments, the form of the cells, and the presence of both sessile and stalked lateral heterocysts , but it does not agree with any described species of that genus. A. G.

Missouri Myxophyceæ.—FRANCIS DROUET ("New or Interesting Myxophyceæ from Missouri," *Bot. Gaz.*, 1934, **95**, 695–701, 12 figs.). The novelties described are *Lyngbya hahatonkensis*, a new species, and new varieties of *Phormidium purpurascens* and *Plectonema notatum ;* and notes are given on nine other species ; all are figured. The most reliable diagnostic characters are the size and shape of cells, especially those at the ends of the trichomes, and the reaction of chlor-zinc-iodine upon the sheaths. A formula for the preparation of chlor-zinc-iodine is given. A. G.

Antithamnion.—M. A. WESTBROOK (" *Antithamnion Spirographidis* Schiffner," *J. Bot.*, 1934, **72**, 65–8, 6 figs.). An account of a red alga found in the relatively warm water of Devonport Dockyard, growing plentifully on the sides of the dock , it was later found on an *Alcyonidium* dredged from Plymouth Sound in 4–6 fathoms. The structure and cell dimensions and the reproduction of the plant are described and figured. The differences from *Antithamnion cruciatum* are pointed out, and the Devonport alga is referred to *A. Spirographidis* Schiffn., which has previously been recorded from Trieste and the Gulf of Naples, whence it was probably brought to Plymouth on the hull of a vessel. A. G.

Gymnogongrus and Ahnfeltia.—BERYL D. GREGORY (" On the Life-History of *Gymnogongrus Griffithsiæ* Mart. and *Ahnfeltia plicata* Fries," *J. Linn. Soc. Bot.*, 1934, **49**, 531–51, 26 figs.). A résumé is given of the conflicting views of previous authors as to the parasitism of *Actinococcus* and *Stereocolax ;* and it is shown that *Actinococcus aggregatus* is not parasitic but is the asexual biont of *Gymnogongrus Griffithsiæ* developed upon the sexual plant. *Gymnogongrus* produces many procarps which fail to develop further ; but a few of them develop, giving rise to a pustule by proliferation of the enlarged bearing-cell of the carpogonium. Chains of cells are formed ; some of them growing outwards collect beneath the cuticle and form the mature pustule (*Actinococcus*) with its rows of tetraspores. Also it is shown that *Sterecolax decipiens* is not a parasite, but an integral part of *Ahnfeltia plicata.* It arises as a result of the subdivision of certain cells in the abnormally developed limiting layer , ultimately monospores are formed from the apical ends of the nemathecial filaments. No trace of a procarp is found ; but possibly the vegetative cells from which the pustule originates represent a very reduced sexual mode of

reproduction. Male plants of *Ahnfeltia* occur, with the male organs in superficial sori protected by a very thick cuticle. Some of the outermost cells of the cortical filaments function as spermatangial mother-cells; they produce elongated colourless spermatangia, from which spermatia are developed. The existence of these spermatia suggests that the pustule is the result of reduced sexuality, the female organ remaining incompletely developed. A. G.

Sargassum.—WILLIAM ALBERT SETCHELL ("Hong Kong Seaweeds. III. Sargassaceæ," *Hong Kong Naturalist, Supplement*, no. 2, 1933, 1–49, 18 pls). Fourteen species of *Sargassum* from Hong Kong are defined, discussed and figured. Two new species of the subgenus *Bactrophycus* are described. Some of the species of earlier anthors are shown to be merely synonymous with *S. siliquastrum* (Turn.) Ag. A. G.

Great Salt Lake Algæ.—SEVILLE FLOWERS ("Vegetation of the Great Salt Lake Region," *Bot. Gaz.*, 1934, **95**, 353–418). Included in this general account of Utah vegetation are some algæ. Native to the waters of the Great Salt Lake are *Aphanothece utahensis*, *Microcystis Packardii*, *Oscillatoria tenuis*, *Tetraspora lubrica*, a *Chlamydomonas*, and several diatoms unnamed Salt-marshes in the vicinity contain *Aphanothece nidulans*, *Tolypothrix tenuis*, *Enteromorpha intestinalis*, *E. plumosa*, and species of *Cladophora* and *Chlamydomonas*. In sloughs, wetter and more saline than the marshes, more than twenty Myxophyceæ and a dozen Chlorophyceæ are found. Hot mineral springs (about seven were investigated) yielded eleven species of *Oscillatoria*, four of *Phormidium*, and other Myxophyceæ. A. G.

Indian Algæ.—F. BØRGESEN ("Some Marine Algæ from the Northern Part of the Arabian Sea with Remarks on their Geographical Distribution," *K Dansk Vidensk. Selsk. Biol. Medd.*, 1934, **11**, no. 6, 1–72, 2 pls., 8 figs). A systematic list of the 134 species of marine algæ hitherto found at Karachi, Okha Port and Dwarka, collected by the author himself during the winter 1927–8, or found in collections sent to him for determination. To the novelties already described elsewhere are now added *Valoniopsis*, a new genus founded on the alga distributed as *Valonia confervoides* by Harvey and described as *Bryopsis pachynema* by Martens; *Dasya flagellifera* a new species; and *Gonodia arabica* is a new name for a little-known old brown alga figured by Kutzing. The distribution of all the species is displayed in a table, and some remarkable facts of distribution are discussed in the concluding chapter; for example fifty-four of the species are also found on the coast of Australia and fifty-five are also Japanese. A. G.

Standardized Illustrations.—JOSEPHINE E. TILDEN ("Standardization of Method for Drawing Algæ for Publication," *Bot. Gaz.*, 1934, **95**, 515–18, 19 figs). An account of the scheme adopted in the phycological laboratory of the University of Minnesota for the making of standardized drawings of algæ for publication, with a table of magnifications and factors, a number of sample drawings, and an indication of precautions to be taken. A. G.

Fungi.

Tobacco Stem-Burn.—A. MEURS ("Parasitic Stem-Burn of Deli Tobacco," *Phyto-path. Zeitschr.*, 1934, **7**, 169–86, 19 text-figs.). Three of the four fungi which cause stem-burn were isolated, *Pythium aphanidermatum*, *P. myriotylum*, and *P. deliense* n. sp. They are described morphologically and culturally. The new species is related to *P. Indigoferæ* Butl. An account of symptoms, control, and distribution of the disease is also given. F. L. S.

Cordyceps.—W. A. JENKINS ("The Development of *Cordyceps agariciformia*," *Mycologia*, 1934, **26**, 220–44, 2 pls , 1 text-fig.). The development is studied from the initiation of the clubs until the spores are mature. The stipe of young clubs consists of central compact longitudinally arranged hyphæ surrounded by loosely interwoven ones. The head consists also of a central core and a peripheral zone of closely woven fine hyphæ and an intermediate region of loosely interwoven and coarser hyphæ. The ascogonia arise in the intermediate zone. No antheridia were observed. Asci and spores were studied cytologically. F. L. S.

Neurospora Hormones.—ALICE ARONESCU ("Further Tests for Hormone Action in *Neurospora*," *Mycologia*, 1934, **26**, 244–53, 1 pl). The author never found perithecia with asci in any of her cultures derived from single normal heterothallic spores and she is convinced that perithecia, as distinct from sclerotia, resulted in every case only when two opposite mating strains come into actual contact. Stimulants may induce fertile perithecia to form more readily but will not produce them from a heterothallic strain. F. L. S.

Diplocarpon.—ALICE ARONESCU ("*Diplocarpon Rosæ*: from Spore-Germination to Haustorium Formation," *Bull Torrey Bot. Club.*, 1934, **61**, 291–330, 5 pls., 32 figs.). A saturated atmosphere and a temperature of 75°–80° F. form the best conditions for the growth of the fungus on rose-leaves, twigs, and petioles, spots then appear on the third day. Appressoria, when they occur, develop within nine hours. At first three kinds of hyphæ ensure the spread of the fungus and its penetration into the tissues, but finally a fourth kind is produced. This fungus is thought to represent a transition stage of adaptation to parasitic life. F. L. S.

New Genus of Xylariaceæ.—F. L TAI ("Notes on Chinese Fungi. IV. *Xylariopsis*, a New Genus, of Xylariaceæ," *Sinensia*, 1934, **4**, 209–15, 4 figs.). Externally this fungus, of which only one specimen was found, looks like a *Xylaria* but differs microscopically by its filiform and multiseptate spores. The fungus is black, about 4·5 cm. long, was found on a dead branch of *Bambusa*, and has been isolated in culture. F. L. S.

Chinese Hysteriales.—S. C TENG ("Notes on Hysteriales from China," *Sinensia*, 1933, **4**, 129–45, 15 figs) In this descriptive list of seventeen fungi the following are described as new, their structure being well illustrated in the drawings: *Hysterium sinense*, on bark of deciduous trees, *Lophodermium Camelliæ* and *L. Rosæ*. F. L. S.

Humaria.—ADOLF JAHN ("Über Wachstum, plasma-strömung und vegetativefusionen bei *Humaria leucoloma* Hedw.," *Zeitsch. f. Bot.*, 1934, **27**, 193–251, 10 text-figs.). The mycelium consists of surface and aerial hyphæ. Food material, absorbed by the creeping hyphæ, is transported very rapidly to the aerial portions by protoplasmic streaming and can be as fast as 250μ per second. Growth is also very rapid. The quick change of osmotically active substances into protoplasm together with the guttation at the hyphal tips ensures the increasing streaming motion. Various causes bring about alteration in the direction of streaming, among these being hyphal fusions. F. L. S.

Australian Rust.—W. L. WATERHOUSE ("Australian Rust. Studies IV. Natural Infection of Barberries by Black Stem Rust in Australia," *Proc. Linn. Soc. New S. Wales*," 1934, **59**, 16–9, 1 pl., 3 figs.). It had been believed for a long time that in Australia black stem rust did not infect Barberry. In December, 1933, however, rust-infected Barberry was found. The fungus is *Puccinia graminis-tritici* form 34 and occurs also on *Agropyron scabrum.* F. L. S.

Plasmolysis of Rusts.—L. RONSDORF ("Über Plasmolyse und vitalfärbung bei sporen und jungen Keimschläuchen von Getreide-rostpilzen," *Phytopath. Zeitschr.*, 1934, **7**, 31–43, 2 text-figs.). True plasmolysis occurred both in the spores and germ-tubes of *Puccinia simplex;* in the case of the latter, however, only in those tubes still completely filled with protoplasm. The osmotic tension of the spores is greater than that of the germ-tubes and that of the fungus greater than that of the host plant. By long immersion in cane sugar solution the germinative power of the uredospores of *Puccinia simplex*, *P. triticina*, and *P. coronifera* is greatly reduced and only the two latter show any signs of germination after such treatment. Vital staining took place with neutral red. F. L. S.

Lepiota.—S. M. ZELLER ("A New Species of *Lepiota*," *Mycologia*, 1934, **26**, 210–2, 1 pl.). This fungus, *Lepiota Barsii*, which occurs plentifully in pastures, fields, and gardens in September in Western Oregon is distinguished from *L. naucina* by its grey colour and scaly pileus, its even-edged gills of coarser texture, and by its non-swollen stem. F. L. S.

Russula.—JULIUS SCHAEFFER ("*Russula* Monographie," *Ann. Myc.*, 1934, **32**, 141–244, 4 pls.). This is the final and general section of the monograph, and includes detailed observations on the colour, texture, form, size, and chemical reactions of the pileus, lamellæ, stipe, spores, and hymenium. Particulars of distribution, fruiting time, ecology, classification, and nomenclature also are included. This is followed by synoptic keys under various heads such as colour of cap, lamellæ, chemical reactions, smell, etc. Finally there is a supplement on the systematic section and an index. F. L. S.

Rhodophyllus.—H. ROMAGNESI ("Sur les *Rhodophyllus*," *Bull. Soc. Myc. de France*, 1934, **49**, 422–38, 1 pl., 5 text-figs.). The paper is divided into four sections, one dealing with the evolution of spore volume and the classification of spores, and three others applying some crystallographic data, obtained in the first part, to systematic problems in the genus *Richoniella* and some species of *Rhodophyllus* (*Nolanea* in part). Two types of spores have been distinguished by Kuhner and Boursier, a cubical and a prismatic, but the author finds intermediate forms and disputes the significance of truncation transforming the faces and ridges of polyhedral spores. He considers that development can proceed by successive changes on the apico-dorsal face, and that these changes proceed in two steps; the peak is first pulled out laterally to make a fourth face which then bulges in the middle to form a longitudinal crest. This developmental cycle is repeated automatically by the appearance of a new triangular apico-dorsal face, so that a new type of spore can arise and has been observed both in symmetrical and asymmetrical spores.
F. L. S.

Rare Toadstools.—H. C. BEARDSLEE ("New and Interesting Fungi," *Mycologia*, 1934, **26**, 253–61, 3 text-figs.). Six rare fungi were discovered in Florida and Ohio. *Tylopilus conicus*, apparently not found since 1853, is a pink-spored *Boletus* with pink tubes and white cap bearing a bright yellow fibrous network. *Mycena glutinosa* is described as new. It is pure white, very viscid and has a convex striatulate pileus depressed in the centre. *Russula heterospora*, also a new species, differs from other Russulas by its thick-walled, smooth, narrowly ellipsoidal spores. In general appearance it resembles *R. variata*. The other species recorded are *Amanita pantherina*, *Pluteus coccineus*, and *Chamæota pusilla*.
F. L. S.

Hydnaceæ.—L. W. MILLER ("The Hydnaceæ of Iowa. III. The genera *Radulum*, *Mucronella*, *Caldesiella*, and *Gloiodon*," *Mycologia*, 1934, **26**, 212–20, 1 pl.). A diagnostic account with notes and keys of three species of *Radulum*, two of *Mucronella*, one of *Caldesiella* and one of *Gloiodon*. Basidia, spores and hyphæ are illustrated in the plate. F. L. S.

Xanthochrous.—L. LUTZ ("Les champignons du genre *Xanthochrous*, agent de destruction des bois sur pied ou abattus," *Bull. Soc. Myc. de France*, 1934, **49**, 377–84). *Xanthochrous hispidus* and *X. cuticularis* are active destroyers of cellulose and attack a number of timber trees in France. The fact that plane trees in Paris are commonly destroyed had brought these fungi some notoriety. They cause a gummy degeneration of the wood. F. L. S.

New Fungi.—H. SYDOW ("Novæ fungorum species—XXII," *Ann. Myc.*, 1934, **32**, 286–300). A detailed account of thirteen new species and one new genus, *Phasya*, which forms thin, more or less circular crusts. There are numerous loculi containing 8-spored asci The ascospores are hyaline and once septate. The fungus resembles *Aphysa*. F. L. S.

French Micromycetes.—T. RAYSS ("Deuxième contribution à la connaissance des Micromycetes des environs de Besse (Puy de Dôme)," *Bull. Soc. Myc. de France*, 1934, **49**, 381–421). This is a continuation of the author's previous work on the fungus flora of this area and like the previous one is a systematic account. A certain number of fungi rare or new to France or having new host-plants were found. Oospores of *Peronospora pratensis* Sydow and *P. Sanguisorbæ* Gaumann have been described that previously were not known and also the new species, *P. Moreaui* from *Lathyrus macrorhizus*. A frequency curve of conidial size is included. F. L. S.

German Fungi.—H. SYDOW ("Mycotheca Germanica. Fasc. LIII–LVI (no. 2601–2800)," *Ann. Myc.*, 1934, **32**, 272–86). This paper includes a list of 200 micro- and larger fungi, descriptions of thirteen known species, of four new species and of one new genus, *Allonema*. F. L. S.

Myriogenospora.—W. W. DIEHL ("The *Myriogenospora* Disease of Grasses," *Phytopath.*, 1934, **24**, 677–82, 2 text-figs.). The effects of the disease, fasciation, and dwarfing, are thought to be due to a mechanical binding, by the fungus hyphæ, of adjacent leaves and culms during the growth of the shoot. F. L. S.

Criticism of Species.—MARCEL JOSSERAND ("Notes critiques sur quelques champignons de la region lyonnaise," *Bull. Soc. Myc. de France*, 1934, **49**, 340–76). The author considers that many of the difficulties of present-day mycology could be solved if a certain number of forms could be excluded from inquiry as sufficiently known. He has accordingly made a number of careful microscopic observations on certain agarics, particularly species of *Mycena*, *Hygrophorus*, and *Russula* in the hope of defining them accurately. Cystidia, spores, and epispore structure have received special attention. Many new disagreements are noted. F. L. S.

Trigonia.—K. B. BOEDIJN ("Über die neue gattung *Trigonia* van Beyma thoe Kingma," *Ann. Myc.*, 1934 ,**32**, 302). The name *Trigonia* cannot stand as it has already been used for a flowering plant. The name *Triangularia* is proposed instead. F. L. S.

Mycology.—C. L SHEAR ("Mycology, Scientific and Otherwise," *Mycologia*, 1934, **26**, 201–9). This is a presidential address in which the experience of years is expressed in joyous advice. It is regretted that most training militates against scientific development, and warnings are uttered on the futility of much monographic study. Physiological species differentiation is regretted and an ultimate licensing of systematists is hinted at. F. L. S.

Bitter-Pit.—D. ATANASOFF ("Is Bitter-pit of Apples a Virus Disease?" *Phytopath. Zeitschr.*, 1934, **7**, 145-68). The history of our knowledge of this disease shows that investigators have inclined to attribute it to physiological causes. The author considers all causes to resolve into a virus or a group of viruses, largely on the basis of a statement that physiological breakdown theories have not withstood experimental test. The similarity of the disease to a number of others now thought to be due to a virus and the records of grafting experiments are regarded as conclusive. F. L. S.

Mycetozoa.

Mycetozoan Habitats.—ROBERTSON PRATT ("Fruiting Relations of some Mycetozoa," *Torreya*, 1934, **34**, 37–40). The author concludes that there may be a close connection between vegetative stages of different species and specific kinds of wood and leaves, but that the sporangial forms apparently depend more on moisture conditions. He regards the sporangial forms of New York Mycetozoa as falling into three groups: (1) those occurring on relatively firm to hard and sound wood or dry leaves or both, (2) those on soft disintegrating wood or wet decaying leaves or both, (3) those which occur in either wet or dry places. F. L. S.

TECHNICAL MICROSCOPY

A Simple Photomicrographic Camera.—W. L. Robinson (*J. Tech. Methods and Bull. Internat. Assn. Med. Mus.*, 1934, **13**, 67–70, 2 text-figs.). As illuminant a Zeiss "Punklicht-Lampe" or a Bausch and Lomb Ribbon filament lamp is suitable. The camera is a box with a rectangular base, made to hold a 4 × 5 inch plate-holder. Towards the top it expands posteriorly to allow for a viewing aperture through which the focussing is done and in front of this room for a surface mirror. Projecting forward from the front is an extension of the camera having an internal cross-section diameter 1½ inches square and a length of 6 inches over all. At the outer end of the extension and on the under surface is an opening with a metal tube measuring 1½ inches in diameter and extending below the extension for ⅞ inch. In the outer end of the extension a right-angle prism measuring ¾ inch square is set. This is fastened to a hinged block in such a way that the distal end of the extension can be opened and oculars changed. The surface mirror measures 2½ × 2¾ inches and is set at an angle of 45 degrees to deflect the image onto the baseboard in the bottom of the camera box The baseboard measures 4¼ × 6½ inches, and is supported by three coiled springs. It fits inside the box but projects slightly through an opening on the right side. The upper surface is painted a dead white colour, and the projected image is focussed on this surface. It is then depressed slightly and the plate holder slid in over it through the opening on the right-hand side The coil springs with the baseboard then holds the plate-holder in proper position for photographing On the top of the camera at the front is an oval shaped opening with a wooden shield built round it. A small metal shutter is provided which slips over the opening when ready to make an exposure.

G. M. F.

NOTICES OF NEW BOOKS

Transactions of the Bose Research Institute, Calcutta.—By Sir J. C. Bose, 1934. Vol. VIII. 1932-3. vi + 266 pp., 131 text-figs. Published by Longmans Green & Co., 39, Paternoster Row, London, E.C.4. Price 21*s*. net.

An Index to the Genera and Species of the Diatomaceæ and their Synonyms. 1816–1932. Compiled by F. W. Mills. Part XIII. June, 1934. Me–Na. 79 pp. Part XIV. July, 1934. Na–Na. 79 pp. Part XV. August, 1934. Na. 81 pp. Published by Wheldon & Wesley, Ltd., 2, 3, and 4, Arthur St., London, W.C.2. Price 10*s*. per part.

REVIEWS

Anleitung zu optischen Untersuchungen mit dem Polarisationsmikroskop. —By Prof. F. Rinne and Prof. M. Berek. viii + 279 pp., 335 text-figs. 1934. Published by Dr. Max Janecke Verlagsbuchandlung, Leipzig. Price RM 11.60.

This guide to optical investigation with the polarizing microscope is divisible into two main sections, crystallography and applied crystal optics. The chapter on crystallography has been contributed by Prof F. Rinne, who has not, unhappily, lived to see the book in print. Two minor criticisms of this section of the work may be advanced, firstly the system of numbering the thirty-two crystal groups is not generally accepted, in fact the order of the crystal systems is different in each text-book on the subject, and secondly only the Bravais-Miller indices are given for the trigonal system, whereas some mention of the Miller system of referring the indices to three equally inclined equal axes might have been advantageous. The chapters dealing with polarized light methods have been written by Prof. M. Berek, and constitute a very clear and readable account not only of the main principles of the subject, but also of the most recent developments, amongst which may be mentioned universal stage methods; the use of a heated hollow hemisphere in conjunction with a two-circle universal stage for refractive index measurements by Emmon's single-variation method; the integration stage for planimetric determination of mineral or metal constituents; Berek's microphotometer for the measurement of the optical constants of absorbing crystals, and for absorption measurements of liquids and solids by transmitted light, and the recently developed Ultropak illuminator for the examination of substances by incident polarized light.

English readers in particular will find the many excellent illustrations a considerable aid to the understanding of the text. On the whole this book will furnish workers in the field of applied crystal optics with a valuable guide to modern methods of attacking specific problems, and to the choice of suitable quantitative apparatus.

E. E. J.

Précis de Microscopie.—By M. Langeron. 1934. xx + 1205 pp., 365 text-figs. Published by Masson et Cie, 120, Boulevarde St.-Germain, Paris. Price 100 fr.

This work is one of a series of Medical Publications and treats the subject from that point of view, Petrology and Metallurgy for instance are not included.

It is a severely practical book, and one must not look for the history of the Microscope, nor for accounts of discoveries in the domain of pathology. Classification of plants and animals is also excluded.

The first part describes microscopes and accessories and their uses. The instruments are naturally of French manufacture with a few items from the firms of Zeiss and Leitz.

On the subject of optical equipment the author considers achromatic objectives sufficient except for very exceptional purposes, and he also recommends the Abbe condenser instead of an achromatic one. This, however, seems to be a usual practice in medical laboratories even in this country, where the merits of the achromatic condenser have been so very long recognized.

The second part deals with general methods, fixing, staining sectioning preservation, and so forth, and is very complete, the author's personal experience in this and the following section adding greatly to the value of the information given.

The third part describes special methods of investigation of animal and vegetable material, and contains information drawn from every country, nothing of importance to a medical investigator seems to have been overlooked The book is a valuable work of reference, is well bound and has a table of contents and a good index.

J. K. C.

// JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1934.

TRANSACTIONS OF THE SOCIETY.

XV.—A NEW SPECIES OF ROTATORIA (*PTYGURA LIBERA*). 595.18.

(With observations on *Euchlanis pellucida* Harring and *Euchlanis triquetra* Ehrenberg.)

By Frank J. Myers, F.R.M.S.

(*Read November 21st*, 1934.)

One Plate.

Having had the privilege recently of examining and remounting a number of slides of Rotatoria contained in the collection of the British Museum (Natural History), I found four of exceptional interest. These were mounted, in two per cent. formalin solution, by the late Charles F. Rousselet and were labelled as follows: Nos. 270 and 290, *Euchlanis triquetra*, England, 1.10.1894 and 30.9.1894; Nos. 10 and 11, the former labelled Boston Rotifers, 10.12.1907, and the latter labelled *Oecistes* sp. ? Boston, 20.12.1907. On slide 10, Boston Rotifers, besides some other species, were several examples of the *Oecistes* sp. ?, on slide 11.

This *Oecistes* hitherto, has remained undescribed. It was collected in Fowler Lake, Wisconsin, by Harring in 1919. In 1933 Mr. Thomas Edmondston sent the author several specimens which he had collected near Carmel, New York. Finally, it appeared again in January of 1934 among the slides sent me from the British Museum, so it seems Rousselet was the original discoverer and found the rotifer twelve years before Harring found it.

Rousselet's description, while very good as far as it goes, is somewhat fragmentary and without a figure (Rousselet, 1908, *op. cit.*, p. 338). Besides,

he did not name the rotifer, hoping, as he suggested, that some member of the Boston Society of Natural History would look for it and supply a description and figure.

Order : MONOGONONTA.
Sub-order : FLOSCULARIACÆ.
Family : Flosculariidæ.
Ptygura libera, new species.

The rotifer is free swimming. It inhabits a large, perfectly clear, pyriform test, open anteriorly and closed posteriorly. Inside of the test there is a distinct cylindric sheath into which the rotifer contracts on irritation and which generally carries one or two developing ova.

The body tapers regularly to a rather short foot which is fixed to a long, slender peduncle, the posterior end of which lies free in the sheath.

The corona is circular and there is a well-marked median notch on the ventral side. The trochus is interrupted dorsally by a small gap, and there are two apical, red eyespots.

The ventral antennæ are very long, being nearly equal in length to the width of the corona.

The mastax is malleo-ramate and each ramus has four opposed functional teeth. The remainder of the anatomy is quite normal.

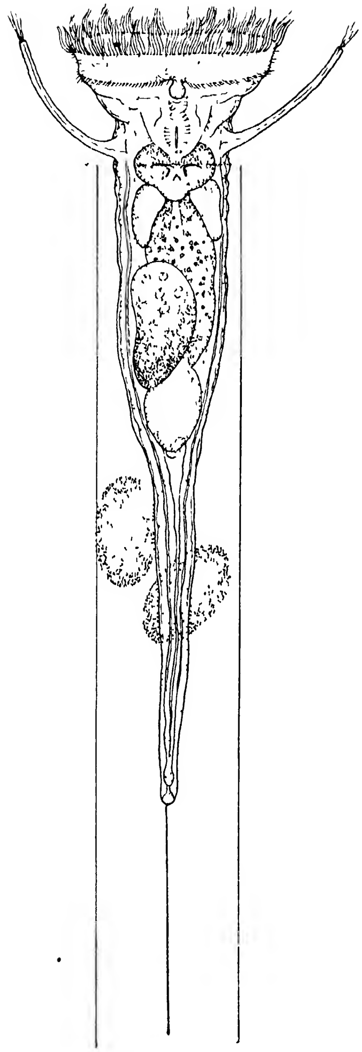
Rousselet's measurements agree well with the specimens from Fowler Lake. Length of tube, 350 μ ; body, 240 μ ; peduncle, 65 μ ; lateral antennæ, 45 μ.

Habitat : Boston, Massachusetts ; Carmel, New York ; Fowler Lake, Wisconsin.

Rousselet says, " the test is semi-opaque and the anterior two-thirds covered with brown material in the form of rodlets." This was probably a local manifestation, as the tests of all the specimens from Fowler Lake were remarkably transparent and could only be resolved by means of dark-ground illumination. The sheath, however, is very apparent and gives an impression of being the test proper. In mounted specimens the formalin often dissolves the test completely, leaving nothing but the animal itself and the sheath.

Euchlanis pellucida Harring and *Euchlanis triquetra* Ehrenberg.

Euchlanis pellucida is cosmopolitan in distribution. It was described by Harring in 1921 (Harring, 1921, *op. cit.*, p. 6), from material collected by Jessup in lakes on Old Crow Flats, Alaska. Besides having been found in numerous localities in North America, it has been reported from various European countries. It is without doubt an acid water rotifer. While it is true it has been collected in water running as high as pH 7·4, it occurs frequently in great abundance in regions of very acid water. In certain locations in Atlantic County, New Jersey, where the pH of the water is only 5·0, it is frequently the predominating species, and is almost certain to be found in



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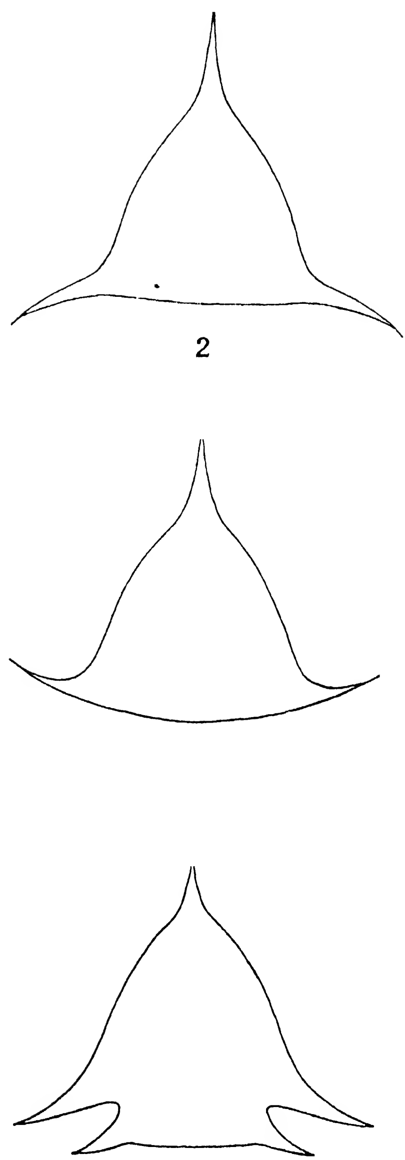

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bodies of bog water having an acid reaction, provided there is a vigorous growth of submerged aquatics, especially *Sphagnum*. From such locations *Euchlanis triquetra* is practically absent.

During the month of March, 1933, Mr. David Bryce found *Euchlanis pellucida* in collections sent him from pools near Napier Arms, Epping Forest. This was supposed to be the first time this *Euchlanid* was recorded from England.

On removing the rotifers from slides Nos. 270 and 290, labelled *Euchlanis triquetra*, the contents were found to be fine examples of *Euchlanis pellucida*.

The differences between the two species, which can easily be overlooked, are that *Euchlanis pellucida*, besides being uniformly larger than *Euchlanis triquetra*, has no true ventral plate; and the longitudinal, lateral sulci which are invariably present in *Euchlanis triquetra* are absent in *Euchlanis pellucida*.

From the above we learn that the first record of *Euchlanis pellucida* being found in England was on September 10th, 1894, long before it was collected elsewhere.

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HARRING, H. K. (1921).—"The Rotatoria of the Canadian Arctic Expedition, 1913–1918." Report Canadian Arctic Expedition, 1913–1918. VII. Pt. E: Rotatoria, 3–23.

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DESCRIPTION OF PLATE.

Fig. 1.—*Ptygura libera* Myers, ventral view.
Fig. 2.—*Euchlanis pellucida*, transverse section, normal form.
Fig. 3 —*Euchlanis pellucida*, transverse section, form with recurved lateral margins.
Fig. 4.—*Euchlanis triquetra*, transverse section.

535.317.8. XVI.—A MICROREFRACTOMETER AND ITS USE IN CHEMICAL MICROSCOPY.*

By EDWIN E. JELLEY, Ph.D., A.I.C., F.R.M.S.

(*Read October* 17*th*, 1934.)

EIGHT TEXT-FIGURES.

THE microscopical identification of chemical substances depends largely on measurements of the refractive indices of crystal fragments. These measurements are usually made by methods which depend on the observation of the well-known Becke line, which is visible when crystal fragments, immersed in a liquid of slightly higher or lower refractive index, are illuminated with an approximately parallel beam of light, and examined at moderate magnification under the microscope. The formation of the Becke line may be explained briefly as follows.† In fig. 1, *a*, the fragment is shown immersed

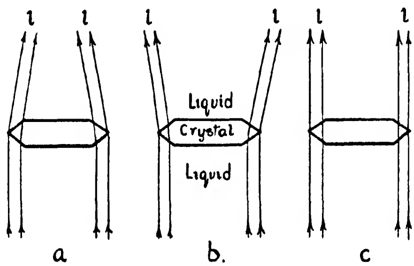

FIG 1.

in a liquid of lower refractive index, and it is obvious that the Becke lines " l " will appear to move inwards, i.e., from liquid to crystal, as the objective is moved upwards, whereas in fig. 1, *b*, in which the liquid has the higher refractive index, they will appear to move outwards from the crystal to the liquid. These results are summarized in the statement that " the Becke line moves towards the more refractive medium when the objective is moved upwards." If, as in fig. 1, *c*, the crystal and medium have the same refractive index, the Becke lines are absent, and the contours of the crystal fragment are practically invisible.

Crystals of other than the cubic system possess two refractive indices

* Communication No. H.537 from the Kodak Research Laboratories, Harrow.

† A full explanation was given by Grabham on pp. 341 *et seq.* of the *Mineralogical Magazine* for 1910.

for any direction in which they are viewed—unless this direction is along an optic axis—and the values of these two indices depend on the orientation of the crystal. In practice, it is necessary to view the immersed crystal by plane polarized light, vibrating in one of the vibration planes of the crystal so that only one set of Becke lines is visible : in this way one of the refractive indices is determined, and the plane of polarization is rotated through 90° for the other. By examining a number of fragments of the crystal, the lowest and highest refractive indices of the substance can be obtained. With uniaxial crystals one of the two indices is the same for all orientations of the crystal fragments : this is N_ω, the other varies between N_ω and N_ϵ, so that the extreme value is N_ϵ. Negative uniaxial crystals have $N_\omega > N_\epsilon$; positive, $N_\epsilon > N_\omega$. This is a useful method of checking that crystals are negatively or positively uniaxial, when sections showing the conoscopic interference figure are not available. With biaxial crystals, both the indices vary according to the orientation, the lowest and highest observed with all orientations being N_α and N_γ respectively. Care is needed in interpreting the results when examining fragments of biaxial crystals which possess a well-marked cleavage plane, for it is then not unlikely that all the fragments will have the same orientation, and the extreme refractive indices will not then necessarily be N_α and N_γ. It is advisable to examine fragments of biaxial crystals conoscopically (i.e., with convergent polarized light), in order to ascertain if various orientations are presented.

Adjusting the Refractive Index of the Immersion Liquid.

The earliest method of making use of the Becke line effect in determining refractive index was by means of a set of liquids having indices varying by 0·005 from 1·440 to 1·740, from which one was chosen by trial and error which had the same value as one of the indices of the crystal fragment. A suitable set of liquids for this purpose is supplied by the Eastman Kodak Company.

More precise methods of refractive index determination are based on the accurate adjustment of the index of the immersion liquid by changing its temperature, and by varying the wave-length of the light used for making the Becke line observations. The single-variation method of changing the wave-length of the light by means of a monochromator was proposed by Merwin, and subsequently developed by Tsuboi. It is, however, to Emmons that the improved technique of varying the temperature of the immersion liquid is due. Emmons introduced a single-variation method in which the temperature of the immersion liquid is raised until its refractive index falls to that of one of the indices of the crystal fragment, and a double-variation method in which the index is roughly adjusted by temperature variation, and accurate adjustment is then made by varying the wave-length. This double-variation method has the particular advantage that a greater refractive index range is available without changing the immersion liquid. In these

methods the actual refractive index of some of the immersion liquid is measured on an Abbé refractometer kept at the same temperature as that of the liquid surrounding the crystal fragments.

The firm of Ernst Leitz have simplified Emmon's single- and double-variation methods by means of an electrically heated hollow glass hemisphere used in conjunction with a two-circle universal stage. The crystal fragments are enclosed with the immersion liquid in a small, concentric hemispherical hollow in the glass hemisphere. When one of the crystal indices has been matched by varying the temperature or the wave-length, the refractive index of the liquid is measured by rotating the hemisphere about a horizontal axis to the position of total reflexion. Thus the apparatus serves as its own refractometer.

In the practical microchemical application of refractive index methods

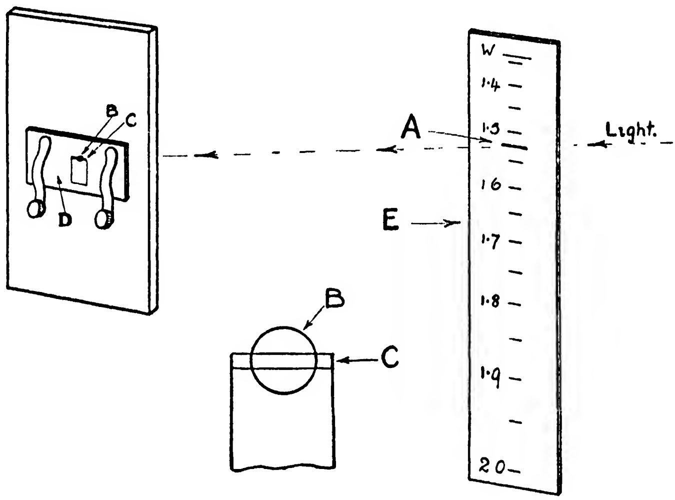

FIG. 2.

it often happens that only a few very small fragments of the crystal substance are available, and considerable care is necessary in order to avoid losing the particles during the preliminary operation of choosing the right immersion liquid. It was in order to overcome this difficulty that the present method was evolved, which depended for its practical success on the development of a microrefractometer capable of determining the refractive index of as little as 0·0001 ml. of liquid with an accuracy of $\pm$ 0·001. Since construction of the instrument, it has been found that it possesses special advantages for organic identification work on micro quantities of substance.

THE MICROREFRACTOMETER.

The instrument, which is of very simple construction, is shown diagrammatically in fig. 2. An illuminated slit A is viewed through a small aperture B. A very small prism C, which consists of a small piece of glass about

0·2 mm. thick, having one edge bevelled at approximately 45°, is placed on a thicker optically worked plate of glass D, so that a minute liquid prism may be formed by applying a micro-drop of liquid to the bevel (fig. 3). The micro-prism C is adjusted so that it partly covers the aperture B, when the effect is that of a camera lucida in which the virtual refracted image of the slit is seen superimposed on the scale E in a position which indicates the value of the refractive index. The micro-prism C may be held in position by the capillary attraction of the liquid itself, or, if it is necessary to work with quantities of less than 0·01 ml. of liquid, it is cemented in position as shown in fig. 8. Seccotine is a satisfactory cement for organic liquids, and canada balsam is satisfactory for most aqueous solutions.

The slit A is best placed in front of the scale, so that the distance from A

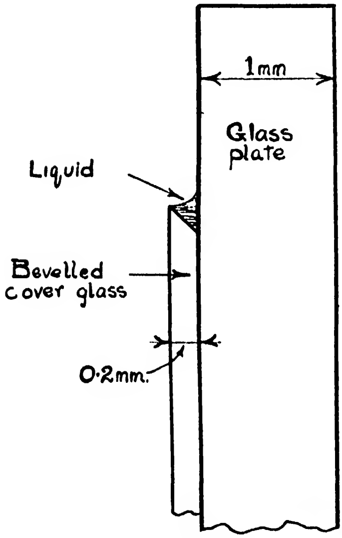

Fig. 3.

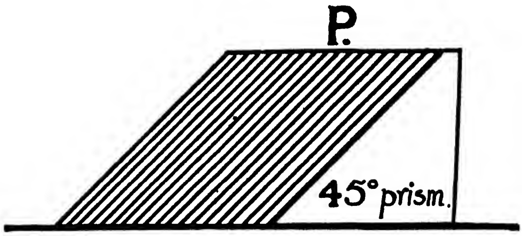

Fig. 4.

to C is equal to the distance from scale division 1·65 to C. This ensures that the eye can focus the scale and virtual image of the slit at the same time. A small slit is cut in the scale at the scale division corresponding to N_D for the glass of the micro-prism, in order that the slit proper may be seen from C. If white light is used to illuminate the slit, its image is dispersed to a spectrum, but it is usually easy to estimate N_D to $\pm$ 0·001 by taking the reading against the yellow. When monochromatic light is used, readings are readily made to within $\pm$ 0·001.

In the first model of the apparatus constructed by the author, the bevelled glass strips were prepared from No. 2 microscope cover-glasses, which were selected for flatness. A number of these were cemented together with shellac as in fig. 4, and the edges P were ground and polished. The bevelled cover-glasses were separated and cleaned, and then cut to suitable dimensions. Optically worked cover-glasses are preferable for this purpose, for it was

found that only a few of the original bevelled strips were of satisfactory optical quality.

The scale is computed as follows. The angle a and the refractive index Ng of the bevelled strip are measured with the aid of a spectrometer or a universal stage. If, as in fig. 5, we call the angle of the glass and liquid prisms α, and the refractive indices for some specific wave-length Ng and Nl respectively, and the deviation, γ, we have

$$\sin \beta = \frac{Nl}{Ng} \sin \alpha \quad \ldots \ldots \ldots \ldots \ldots \quad (1)$$

and $$\sin \gamma = Ng \sin (\beta - \alpha) \quad \ldots \ldots \ldots \ldots \ldots \quad (2)$$

so that $$\sin \gamma = Ng \sin \alpha \left[\frac{Nl}{Ng} \cos \alpha - \sqrt{1 - \left(\frac{Nl}{Ng} \sin \alpha\right)^2}\right] \quad \ldots \quad (3)$$

Values of $\sin \gamma$ for values of Nl for 1·330 to, say, 1·900 are calculated for

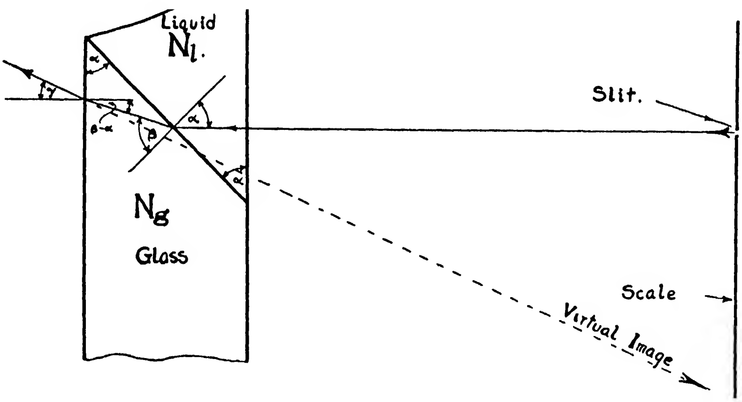

Fig. 5.

0·01 increments, and corresponding values of $\tan \gamma$ are obtained from five-figure tables. It is easiest to use equations (1) and (2) for these calculations. The distance of a scale division Nl from that of zero deviation is equal to $d \tan \gamma + \delta$, where d is the distance from the micro-prism perpendicularly to the scale, and δ is a displacement correction term which is necessary as the scale is viewed through a plane-parallel glass plate. If the thickness of this plate is t, and its refractive index Np, the displacement correction

$$\delta = t \sin \gamma \left[1 - \frac{\cos \gamma}{\sqrt{Np^2 - \sin^2 \gamma}}\right] \quad \ldots \ldots \quad (4)$$

The actual scale for $\lambda = 589$ mμ is shown in fig. 6. It was constructed for a prism angle $a = 41° \ 39'$; N$g = 1{\cdot}5240$; scale distance $d = 283$ mm. The supporting plate had a refractive index N$p = 1{\cdot}5160$. The displacement

corrections δ are calculated for a plate thickness of 1 mm.: this correction is directly proportional to the thickness of the plate. By way of illustration, some of the corresponding values of N*l*, γ, *d* tan and δ are given in the following table :—

TABLE I.

N_D Liquid.	Deviation γ.	*d* tan γ.	δ for *t* = 1 mm.
1·333	−9° 10′	−45·7 mm.	−0·05
1·4	−6° 7′	−30·4 ,,	−0·04
1·5	−1° 13′	− 6·0 ,,	−0·01
1·524	±0°	± 0 ,,	±0
1·6	+4° 13′	+20·9 ,,	+0·03
1·7	9° 29′	47·3 ,,	0·07
1·8	15° 27′	78·2 ,,	0·10
1·9	22° 7′	115·0 ,,	0·14
2·0	29° 52′	162·5 ,,	0·20

For a plate 1 mm. in thickness the maximum error introduced by ignoring δ corresponded to 0·0004 in refractive index, but it should be noted that the error in N introduced by ignoring δ varies inversely as the distance from the micro-prism to the scale, e.g., for a scale distance of 141 mm. the maximum error would be 0·0008.

The temperature of the micro-prism can be regulated by circulating water

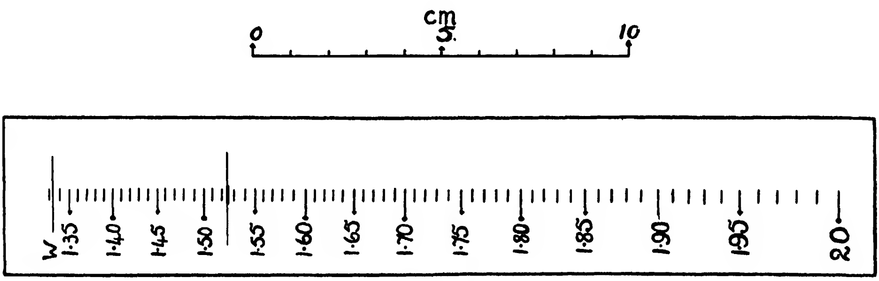

FIG. 6.

of known temperature through channels in an aperture plate as in fig. 7. This plate is preferably made of copper, in order that the heat conduction be as rapid as possible. For the same reason, the plane-parallel glass plate should not be more than 1 mm. thick.

Although the majority of refractive index determinations are made with sodium light, there are often occasions when a knowledge of the dispersion is of value in an identification. The construction adopted for equipping the instrument for the determination of N_C, N_D, and N_F is that of three separate scales mounted on a notched slide so that the appropriate one can easily be slid into position. A hydrogen discharge tube is used for C and F, and a sodium flame for D.

In order to check the scale of the instrument, the refractive indices of a

number of liquids were measured on the microrefractometer, and on a Hilger spectrometer by the hollow prism method, the temperature in both cases being the same. The liquids were all "technical grade."

TABLE II.

Liquid.	Microrefractometer.	Spectrometer.
Water	1·333	1·3330
Ethyl oxalate	1·408	1·4084
Ethyl citrate	1·443	1·4430
N-Butyl phthalate	1·492	1·4925
Ethyl lactate	1·414	1·4132
Carbon tetrachloride	1·463	1·4624
Bromobenzene	1·560	1·5597
Aniline	1·589	1·5884
α-Chloronaphthalene	1·633	1·6336
α-Bromonaphthalene	1·658	1·6583
Methylene iodide	1·742	1·7422

THE DETERMINATION OF Nα AND Nγ OF AN INORGANIC SUBSTANCE.

The Becke line method is used for the determination of the lowest (Nα) and the highest (Nγ) refractive indices of the powdered substance. Some of the powdered crystal is placed in the cavity of an excavated microscope slide, and is then examined with a narrow cone of polarized light with an 8 mm. objective. Two non-volatile liquids of widely different refractive indices are mixed in the cavity in such proportions that the Becke line of a chosen fragment disappears. The fragment is oriented so as to be at extinction between crossed nicols, and the polarizer is then withdrawn. This procedure ensures that one of the vibration planes of the crystal is parallel to the plane of polarization of the incident light. The following liquids were chosen from a large number which were examined.

TABLE III.

Substance.	Boiling Point.	D^{20}_{4}	N_D at 20°	dN/dT.
1. Ethyl oxalate	73° at 10 mm.	1·0793	1·4102	0·00048
2. Ethyl citrate	180° „ 11 „	1·1369	1·4430	0·00036
3. *N*-Butyl phthalate	155° „ 10 „	1·0388	1·4925	0·00032
4. α-Bromonaphthalene	148° „ 16 „	1·4876	1·6582	0·00048
5. α-Iodonaphthalene	160° „ 14 „	1·7344 *	1·702	0·00047
6. Methylene iodide	180° „ 760 „	3·325	1·742	0·00068

* D^{15}_{4}.

With the exception of 4 (α-bromonaphthalene), the values of N_D and dN/dT are measurements by the author on commercial specimens of the compounds.

If, as is often the case, the refractive index of the crystal fragment is higher than 1·443 (ethyl citrate) and lower than 1·658 (α-bromonaphthalene),

it is convenient to start with *N*-butyl phthalate. Should this be too refractive, ethyl citrate is added by means of a micro-stirring rod, or micro-pipette, until the required point is reached : if, however, it is too low, α-bromonaphthalene is added. The liquids must be thoroughly mixed, and it is advisable to place a strip of cover-glass over part of the slide cavity in order to obtain a flat surface to the liquid. When the matching of the lowest or highest refractive index has been effected, a small drop of the liquid is transferred to the microrefractometer, and the refractive index is read. After a little practice, the mixing of the liquids presents no difficulty. Temperature control is unnecessary if the liquids and apparatus have stood in the room for some time.

As the refractive index is matched by a mixture of two liquids of probably different volatilities, it was thought possible that the refractive index of the mixture would change on exposure to the air. In order to find out if

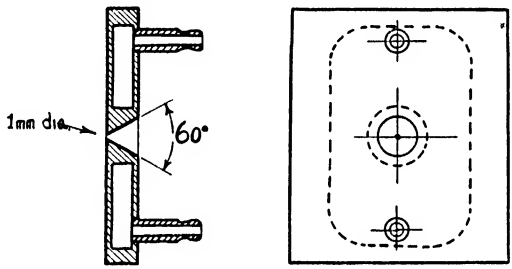

FIG. 7.

differential evaporation was likely to cause any appreciable error in the determination of refractive indices, roughly equal volumes of pairs of liquids were mixed, and a minute drop of the mixture was placed on the prism of the microrefractometer. The refractive index of this drop was read every few minutes. The following results were obtained :—

(*A*) *Ethyl Citrate and* N-*Butyl Phthalate.*

Time in mins.	0	3	5	10	15	20
N_D	1·471	1·471	1·471	1·471	1·471	1·471

(*B*) *Ethyl Citrate and a-Bromonaphthalene.*

Time in mins.	0	2	4	6	12	20
N_D	1·555	1·555	1·554	1·554	1·553	1·552

(*C*) N-*Butyl Phthalate and a-Bromonaphthalene.*

Time in mins.	0	2	5	10	20	30
N_D	1·600	1·600	1·600	1·600	1·600	1·599

(*D*) N-*Butyl Phthalate and a-Iodonaphthalene.*

Time in mins.	0	2	5	10	20	30
N_D	1·619	1·619	1·619	1·619	1·619	1·619

(*E*) *a-Bromonaphthalene and a-Iodonaphthalene.*

Time in mins.	0	5	10	20	30	(18 hours)
N_D	1·680	1·680	1·680	1·680	1·680	(1·685

(*F*) *a-Bromonaphthalene and Methylene Iodide.*

Time in mins.	0	1	2	3	5	10
N_D	1·697	1·695	1·693	1·690	1·681	1·662

(*G*) *Ethyl Oxalate and* N-*Butyl Phthalate.*

Time in mins.	0	1	2	5	10	20
N_D	1·448	1·448	1·448	1·449	1·450	1·455

(*H*) *Ethyl Oxalate and α-Bromonaphthalene.*

Time in mins.	0	1	2	5	10	20
N_D	1·520	1·521	1·522	1·525	1·530	1·541

As readings can usually be made within a minute, the only unsatisfactory combinations of the chosen liquids are (*F*) (α-bromonaphthalene and methylene iodide) and (*H*) (ethyl oxalate and α-bromonaphthalene). It is possible, however, to use mixtures of α-bromonaphthalene and methylene iodide, and also methylene iodide containing dissolved iodides (H. E. Merwin's solution), if the readings are made as soon as the drop of liquid has been transferred to the microrefractometer. Mixtures of Merwin's solution and methylene iodide slowly lose the latter substance by evaporation, and consequently increase in refractive index. With the exception of methylene iodide, and mixtures containing a high proportion of it, the specific gravities of the immersion liquids are below those of practically every known inorganic salt, consequently the crystal fragments do not tend to float. With methylene iodide and Merwin's solution, however, many inorganic crystals float, so that the use of a coverslip becomes necessary in order to submerge them.

Water is useful for checking the scale adjustment, as it has a low temperature coefficient ($d\mathrm{N}/d\mathrm{T} = 0{\cdot}00008$). Its refractive indices at 20° are $N_C = 1{\cdot}3311$; $N_D = 1{\cdot}3330$, and $N_F = 1{\cdot}3371$.

The Microrefractometer as an Aid to the Identification of Organic Compounds.

The method of mounting the micro-prism shown in fig. 8 renders possible the determination of the refractive index of 0·0001 ml. of any reasonably non-volatile liquid. It is possible to make an approximate determination of the boiling point of a similar quantity of liquid, so that two important physical constants can thus be determined on 1 or 2 mg. of substance. Even when the boiling point and refractive index are not sufficient to identify the substance, they narrow down the list of " possibles " very considerably, and a micro-determination of halogen, nitrogen, or some other element will then usually complete the identification.

The microrefractometer is very useful for the detection of mixtures of compounds having different volatilities, for whereas the refractive index of a micro-drop of a pure compound does not change on slow evaporation, that of a mixture generally does so at an appropriate temperature. As an illustration the following experiment may be mentioned :—0·0003 ml. of a mixture of *N*-butyl phthalate and α-bromonaphthalene was placed on the prism of the instrument. N_D was 1·540. The liquid was gently warmed, and cooled to room temperature so that a comparable determination could be made. N_D had fallen to 1·527, and successive similar treatments reduced it to 1·520, 1·511, and 1·503, thus indicating that the liquid of the lower refractive index

had the lower volatility. In view of the necessity of determining whether an organic compound is pure or a mixture before an elaborate microanalysis is attempted, this simple and expeditious test is of no inconsiderable value. Whether or not a separation can be effected depends on the physical and chemical properties of the individual constituents, but even here it is often possible to check a purification by fractionation, etc., by watching the refractive index of the separated substance.

Solid organic compounds present some difficulty, for although a micro-crystallization will usually detect admixture, and often enable a separation to be made, the crystals are in general soluble in the organic immersion liquids used for refractive index determination. There are two ways of attacking

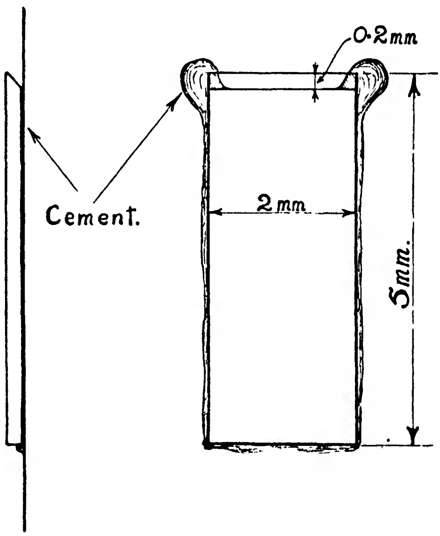

FIG. 8.

this problem. The first is to use certain aqueous solutions as immersion media. A list of solutions which have been tried is given in Table IV.

TABLE IV.

N_D for Saturated Solutions of Certain Inorganic Salts.

Salt.	N_D (saturated solution) at 20°.	Dilute with	Remarks.
1. Lithium iodide ..	1·490	Water	
2. Sodium iodide.. ..	1·496	Water	
3. Potassium iodide ..	1·456	Water	
4. Barium iodide ..	1·528	Water	
5. Lithium mercuric iodide	1·600	10 p.c. lithium iodide	Very poisonous.
6. Sodium mercuric iodide	1·620	10 p.c. sodium iodide	Very poisonous.
7. Potassium mercuric iodide	1·621	10 p.c. potassium iodide	Very poisonous.
8. Tetrasodium dioxy-pentathiostannate ..	1·615	Water	See below.

Tetrasodium dioxypentathiostannate, a complex tin salt isolated by the author, dissolves to give a colourless, neutral, practically odourless and fairly stable solution which is free from the dangerous toxic properties of the alkali mercuric iodides. The solution becomes milky on standing, but clears on boiling for a few seconds. Full details of the preparation of this salt are given in the paper to the Chemical Society (*vide* " Literature Cited "), but it is worth noting that it is not necessary to crystallize the salt for the present purpose. Instead, the preparation is concentrated on the water bath until it reaches the required refractive index, and is then filtered through kieselguhr. The refractive index of the organic crystal is matched by diluting the solution of this tin salt with water, using the Becke line method described above.

The second method of examining solid organic compounds applies to substances melting below 300°. Some of the substance is fused on the micro-prism, and is then cooled in order to crystallize it. The micro-prism is then placed in position, and its temperature is gradually raised until the substance melts—a point which is indicated by the sudden appearance of the virtual refracted image of the salt. The refractive index at the melting point is thus determined. In an instrument under construction an attempt will be made to incorporate electrical heating, in conjunction with a thermocouple calibrated to give the temperature of the micro-prism.

This should enable N_D and the melting point to be determined on a milligramme or so of solid in one operation, for the thermocouple could be calibrated on the instrument with substances of known melting point.

The author has elsewhere described a grating microspectrograph, and technique for determining the dispersion of birefringence of solid organic compounds, and has shown that such determinations are of use in identifications. Refractive index determinations by the present methods should be of particular value when used in conjunction with such measurements of dispersion of birefringence.

Summary.

1. A microrefractometer of simple design is described, which is capable of determining the refractive index of 0·0001 ml. of a liquid with an accuracy of $\pm$ 0·001. It has an available range of 1·330 to 2·000, and can be calibrated for different wave-lengths.

2. A technique of determining the refractive index of solids is given, which depends on the use of mixtures of non-volatile liquids for the Becke line method. The refractive indices are matched by varying the proportions of the liquids. Suitable liquids are ethyl oxalate. ethyl citrate, *N*-butyl phthalate, *a*-bromonaphthalene, and *a*-iodonaphthalene.

3. A suitable immersion fluid for organic crystals having $N_D<1{\cdot}615$ is made by dissolving tetrasodium dioxypentathiostannate in water to saturation.

4. It is suggested that the refractive index of solid organic compounds

having a melting point of less than 300° should be determined at the melting point, as an aid to their identification. The instrument can be constructed so that the melting point and the refractive index at the melting point are determined in one operation.

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XVII.—AMŒBOCYTES AND ALLIED CELLS IN INVERTEBRATA.

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(*Communicated by Prof. J. Bronte Gatenby.*)

Introduction.

The physiological importance of leucocytes in general was first suggested by Virchow in 1858, who discovered the pathological phenomenon of leucocytosis. Since then their activities have been shown to be more and more numerous. Thus were discovered the amœboid movement, migration through the tissues, phagocytosis, and also the secretion of numerous enzymes.

Erhlich first classified the vertebrate types by the staining properties of their granules, basiphil, or oxyphil with intermediate grades. Kollman (1908) by comparative studies, endeavoured to show the parallel existing between these and invertebrate types.

Morphology.

Types.

Kollman (1908) insists that the various types are but evolutionary stages of a single type, in almost every case, and in all groups the evolution follows the same stages.

He recognizes seven types or stages :

1. Hyaline. Stage I.

This is the youngest type. It is always small, with relatively little cytoplasm, and often slightly basiphil.

Multiplication is mainly effected by this type, by mitosis. Amitosis, according to this worker, is very rare.

2. Hyaline. Stage II.

This is a larger form of the first type, with increased cytoplasm, and completely acidiphil reactions.

At this stage the nucleus may be deformed and lobed in various shapes, resembling the polymorphs of vertebrates.

These two are the only types found in Gasteropoda (except *Paludina*), Insects (except Orthoptera), and Asterids. They are not represented at all in Cephalopods.

3. Granular Leucocytes.

Which have the cytoplasm filled with albuminous granules. These are acidophil.

4. Fatty Cells.

Characteristic of Ascidians and also found in Insects.

5. Spherical Cells.

These are found in Molluscs (except Cephalopods), Crustaceans, Arachnids, Echinoderms, Sponges, and even, according to Kollman, in Hydrozoa. They contain enormous albuminous spherules, with basiphil affinities.

They generally lie in the connective tissue (Molluscs and Crustaceans), but may pass into circulation under different conditions (Crustaceans). They are normally in the cœlomic fluid in Gephyreans, Echinoderms, and Scorpions. The genetic connection of these cells with the blood cells is doubtful; their contents may be reserves or excretory products, they certainly excrete ammonium carminate which has been injected into the cœlom. Kollmann thinks the contents are of the same nature as the leucocyte granules, especially as the spherical cells have phagocytic properties also. He concludes, therefore, that they are leucocytes of enormous size, and comparable to the mast cells of Vertebrates.

6. Adipo-Spherical Cells of Annelids and Insects.

They combine the qualities of the last two, being filled with fat globules as well as proteid spheres, but with acidiphil reactions. In Annelids they are free in the cœlomic fluid. The adipose cells of Insects, however, are aggregated in tissue which only becomes dissociated, for example, at metamorphosis. (These are not represented among Vertebrates.)

7. Degenerating Leucocytes.

The nucleus is contracted into a dense mass, deeply staining, and then bursts into fragments. This may occur at any stage, but especially at Stage I after excessive division; and also in the oldest, whether granular or not. The granules sometimes run together into a single mass.

Kollmann draws the following comparison between these types and those found in Vertebrates:

(1) The lymphocytes represent the youngest stage and are also basiphil.

(2) The next stage is represented by the monocytes which are larger, but retain basiphil affinities.

(3) The granular stage is represented by the oxyphil mononuclears.

(4) The invertebrate leucocytes with lobed nuclei are compared to the polymorphs.

(5) The spherical invertebrate cell is compared with the mast cells.

Orton (1923[1]), records large granular, and small hyaline blood cells in *Ostrea.*

Takatsuki (1934) recognises hyaline and granular types in *Ostrea* also.

Tait (1918) (working with *Palinurus, Astacus,* and *Ligia*) records three types of blood cells:

(1) Spindle-shaped corpuscles, with very fine granulation, almost hyaline.

(2) Hyaline, also elongated, becoming spherical on extravasation.

(3) Cells with large refractive granules, staining with eosine.

Drew (1910), in *Cardium norvegicum,* showed three types also:

(1) Finely granular, eosinophil.

(2) Coarsely granular, eosinophil slightly smaller.

(3) Basiphil corpuscles, much smaller, with very little cytoplasm; in the following proportion:

Finely granular	48 p.c.
Coarsely granular	44 p.c.
Basiphil	8 p.c.

Chironomid larvæ are without free blood corpuscles, and Lange (1932) traces the development of a phagocyte tissue, showing that it is the same thing as a leucocyte tissue. In the anal feet of very young larvæ are the cells from which the phagocyte tissue is formed. These cells are relatively large, round, greenish blue, containing refractive granules. They are present in small numbers, embedded in the hypodermis. Larval stages which are coloured with hæmoglobin show formation of the first "spindle" cells near the round ones. The change to spindle form occurs extraordinarily quickly with further growth of the larvæ, and the phagocyte tissue takes on its typical arrangement for the full-grown larva. This is a network, permeable to the blood. Isolated tissue elements are spindle-shaped. Some of the phagocyte cells have two nuclei.

In some cases a few free cells are formed; they are spindle-shaped. As

they are extremely rare, in most cases wanting altogether, and in construction they are like the phagocyte tissue cells, Lange concludes that they escaped from the latter, and calls them leucocytes.

Spherical cells are found in the phagocyte tissue; they are embedded in clumps. They take no part in phagocytosis; the cytoplasm is foamy. They are identical with œnocytes found in the hypodermis.

Kollmann describes the escape of œnocytes from the hypodermis of *Æschna* and *Periplaneta* larvæ, and their circulation in the blood. Lange thinks this is a similar case and that the spherical cells are caught out of the circulating blood by the phagocyte network. They do not appear to be destroyed by the phagocyte tissue, neither do fat cells which also escape from their tissue and come to lie here; nor is there any sign of disintegration.

In the pupæ free leucocytes arise through the destruction of the phagocyte tissue. This tissue, in the *Chironomids*, is therefore specifically larval.

Form.

According to Goodrich (1919), the freely projecting pseudopodia of invertebrate leucocytes are either figured from optical sections of folded membranes, or are due to changes taking place under abnormal conditions.

He concluded that they are provided with more or less extensive processes of cytoplasm and that in most cases the membranous pseudopodia of leucocytes are normally expanded in the living animals, but that fine, projecting pseudopodia are absent. The phagocytes in *Mya arenaria* are described by Yonge (1923), as small, round cells with a central, darkly staining nucleus in which individual chromatin granules are difficult to distinguish. A vacuole is present, but is not easily seen except when occupied by foreign matter.

Goodrich (1898), found a type of cell in *Glycera sephonostoma* which is amœboid, and phagocytic as well as containing a small quantity of hæmoglobin, representing an intermediate state between red and white corpuscles.

Physical Properties.

Amœboid Movement.

Tait (1918) remarks that the forms of movement manifested by different invertebrate blood cells are not identical. Some only are comparable to amœboid movement, which, he insists, is rather the exception than the rule. (The criterion of amœboid movement is that pseudopodia which are protruded are capable of being withdrawn again.)

He questions whether different movements which are peculiar to different types of corpuscles can be termed amœboid. Working with *Palinurus*, *Astacus*, and *Ligia*, he found the same three types of corpuscle, each with its own peculiarity of movement. In the case of two of these types it was

evident that the movement was not amœboid. In the case of the third, a granular cell, the behaviour was similar to that of *Amœba.*

The behaviour of the three types is described thus:

I. Spindle-shaped corpuscles in blood channels, granulation very fine, almost hyaline.

On extravasation these become spheroidal and then send out blebs of clear cell substance which quickly rupture, or coalesce with each other, after which the cell becomes more difficult to see. The nucleus which previously was elongated, is now swollen and spherical; the cytoplasm, or what remains of it, having apparently absorbed water, is surrounded by a delicate membrane. These cells, stained at any phase of their extravascular change of form, show no obvious granules, and have no special tendency to adhere to glass or each other.

II. Hyaline, elongated cells, becoming spherical on extravasation.

Spreading out on glass is accompanied by marked vacuolation of the cytoplasm, and often fusion with other cells of the same type. Free locomotion is absent, and the protoplasmic processes are not retractile.

III. Cells with large, refractive granules, less elongated.

On extravasation these adhere to the foreign substance, only more slowly and with less relative change of surface area. Some are loaded with granules, others have only a small number.

Amœboid movement proper is seen to be present only in the last type of cell. Even in them the power of migration is limited and almost absent in cells with few granules.

The hyaline types having once expanded on the glass are anchored in position and have no power of retracting the cytoplasm. Consequently they cannot be said to possess amœboid movement.

The fully granular cells of *Astacus* blood, while unstable over a considerable area on glass, and consequently more or less anchored in position, can, to a certain extent, detach the adhering cytoplasm. This power, however, which must involve giving out of energy by the cell, is insufficient to permit of effective migration. The fully granular cells of cockroach blood are unstable over a less area of surface on the glass and therefore have greater range of movement. The front part is unstable and pulled continuously on by the surface tension between glass and plasma. The hinder (granular part) is stable and appears also to increase the surface tension between it and the glass, or itself and the plasma, and so continuous migration occurs.

In the cells cited above, contact with a foreign body is evidently the determining cause of the protrusion of pseudopodia, whereas in *Amœba* they may be protruded apart from any contact.

Tait states that the power of amœboid movement in Invertebrate corpuscles is in proportion to the number of eosinophil granules in the cytoplasm. These react positively to Winkler's (indo-phenol-blue) reagent for detecting oxidases, as do also the granules of *Amœba.*

In another work on *Astacus* and *Ligia,* Tait and Gunn (1918) define three types of corpuscle, according to their behaviour :

(1)	Explosive	40–50 p.c.
(2)	Hyaline thigmocytes	20–25 p.c.
(3)	Granular thigmocytes	30 p.c.

The last type they call amœbocytes, as they alone show amœboid movement.

All forms undergo spontaneous cytolysis when received on glass ; " explosive " corpuscles first, then thigmocytes, and last of all, the amœbocytes.

In the explosive corpuscles cytolysis takes place with the formation of a cytolytic membrane by coalescence of extruded vessels.

Thigmocytes, after cytolysis, resemble cytolysed explosive corpuscles and have a similar cytolytic membrane.

The amœbocytes, which are actively amœboid in the vessels, have a certain power of amœboid movement on glass.

Takatsuki (1934) states that the granular leucocytes of *Ostrea* are actively amœboid. " After a lapse of about half an hour many become fully extended and may then measure three or four times their length in the contracted state. In this condition they are very thin, sometimes transparent. . . . The amœboid movement of the lymphocytes is very simple, they produce lobe-like pseudopodia and change their form, but not very actively."

(This description resembles that of Tait and Gunn for their thigmocytes rather than amœbocytes, and it is not clear whether the movement is truly amœboid according to their standards. But, being most noticeable in the granular type, it possibly is true amœboid movement.)

Loeb (1921) agrees that amœboid movement is due to changes in surface tension. The cells (*Limulus* corpuscles) spread out in contact with the glass, but intensity of spreading out and the number of spread-out cells is restricted. Those not in contact with the glass remain contracted for a longer period.

The character of broad or fine pseudopodia (e.g. the petaloid pseudopodia of Goodrich) depends on temperature and osmotic pressure.

Thigmotaxis.

This phenomenon is exhibited when the corpuscles come in contact with a foreign body. Tait (1918) shows that what is loosely called amœboid movement is often only thigmotaxis. It is especially remarked by him in Types II and III of the Crustacean corpuscles he has described. Both forms expand into a thin sheet, and the angle of contact with the glass is very small.

He insists also that the mere spreading of the hyaline thigmocytes on glass cannot be taken as evidence of vital activity. He compares the behaviour of a drop of water under similar conditions. Thigmotaxis does not take place on a greasy surface, and similarly a drop of water on a greasy surface is little deformed. He says the fact that the essential behaviour of thigmocytes may be imitated by physical models leads to the conclusion that distortion,

on contact with suitable foreign bodies, is due to capillary forces. He defines a thigmocyte as a cell that is unstable in contact with a slab of non-greasy material. A great number of invertebrate blood cells and mammalian platelets are thigmocytes.

Phagocytosis.

Haeckel, in 1862, first showed the existence of phagocytosis in blood corpuscles. His experiments consisted of injecting indigo in Molluscs (*Thetis, Helix*) and Crustacea (*Astacus*). Metchnikoff (1883), was led to it by the study of intracellular digestion in Planarians, which he compared with digestion in Protozoa. His early observations were made with *Daphnia*, but he later made exhaustive comparative studies.

Drew (1910) showed phagocytosis of bacteria in the corpuscles of *Cardium norvegicum*. He describes pseudopodia coming out and engulfing the bacteria.

Basiphil corpuscles do not seem to have this power, nor do agglutinated corpuscles, although mobile bacteria may adhere to them.

Tait (1918) is doubtful as to which of the three Crustacean types of corpuscle described by him is phagocytic, but at least the hyaline thigmocytes ingest small particles.

Tait and Gunn (1918), investigating the corpuscles of *Astacus*, carried out many injection experiments and found that both hyaline and granular types are capable of ingestion, but that the former (which also flatten out more promptly on glass) are more actively phagocytic. The same was found for corresponding corpuscles of *Ligia*. The strong adhesion manifested by Amphibian spindle cells (thrombocytes) and Crustacean thigmocytes toward glass naturally suggest a physical explanation of phagocytosis. Accidental contact of a small particle with the cell would, in the first instance, lead to adhesion; and then the same conditions which cause the cell material to flow out on glass might cause it to flow round the surface of the particle, and when it met on the other side the particle would be ingested. From this point of view the spreading out of cell material on glass might be considered an abortive attempt at phagocytosis. Although the two cases seem so dissimilar, the different result might be explained by the different extent of foreign surface available to the cell. If this is a capillary phenomenon, it shows that amœboid movement is not an essential property of a phagocytic cell, for the hyaline thigmocytes are not amœboid.

Tait and Gunn, in the same Crustacean blood cells, found that the power of ingesting foreign particles is limited to the thigmotactic cells. Explosive corpuscles are devoid of phagocytic properties, and the amœbocytes are less phagocytic than the thigmocytes. They are incapable of ingesting simple oily or lipoid particles, but if an emulsifying agent is used to prepare an oily suspension, phagocytosis takes place. These workers remark that a great fall in number and occasionally death may follow the injection of ordinary

particles (e.g. indian ink, carmine, glass, erythrocytes, milk, etc.), whereas simple oily substances do not have this effect.

Orton (1923[1]), records phagocytosis of spindles (degenerated muscle) in the blood of *Ostrea.*

Takatsuki (1934) injected carmine, indian ink, etc., into *Ostrea* and found that amœbocytes congregated at the place of injection and the particles were ingested. He points out that it is probable that amœbocytes are attracted when foreign substances enter, in the same way as phagocytes aggregate at foci of infection.

(As Yonge's work with phagocytes is largely in connection with digestion, the review of it will be deferred to that section.)

Diapedesis.

This, of course, is a function of amœboid movement; Yonge (1926[1]), records in *Ostrea* the abundance of phagocytes everywhere, appearing to pass freely through the tissues. There can be no doubt, he says, that the cells are amœboid and have the power of wandering through the tissues and in and out of the lumina of gut and blood-vessels.

Orton (1923[1]), also working with *Ostrea,* notes that one symptom of weak oysters is extensive diapedesis (less correctly called " bleeding "). Masses of blood cells were extruded, one as large as 6 × 3 mm.; no fluid was noticed at the same time. The extrusion, therefore, of blood cells only, without liquid, could only take place by extensive diapedesis. There is no doubt that this occurs, especially in poisons such as mercuric chloride, picric acid, T.N.T. (although " bleeding " may also occur in clean sea water).

PHYSIOLOGY.

Yonge (1923), in *Mya arenaria,* describes phagocytes containing typically brownish masses, several times the size of the ingesting cells. The masses stain darkly with osmic acid and appear to be of fatty nature. This supports the evidence of Gutheil (1912) who studied the masses in *Anodonta* and regarded them as nutrient material. Dakin considers the phagocytes to be excretory owing to their resemblance to excretory cells in the pericardial gland. Although they are common in the connective tissue of *Mya,* Yonge notes that they rarely contain ingested matter in that area, and moreover there is a certain area in the stomach in which phagocytic action is intense, the material ingested consisting of small sand grains, diatom tests, etc. It is thus extremely difficult to say whether they are primarily nutritive or excretory, but they are probably both.

Digestion.

The phagocytes of *Mya* are everywhere in the epithelium of the stomach; Yonge (1923), states that it is possible that they have no selective action

one way or the other, but they are especially numerous in this region and ingest both digestible and indigestible particles indiscriminately, so that the grooved area acts both as a sorting and absorbing centre.

Referring still to Lamellibranchs, Yonge (1926[1]), states that food is ingested directly both by phagocytes and by the tubules of the digestive diverticula. Digestion is intracellular. Masses which may be of use to the animal, such as iron or blood corpuscles, are carried away in amœbocytes.

Gutheil (1912) has described and figured, in *Anodonta,* the passage of phagocytes, laden with material, from between the epithelial cells, through the basement membrane into the connective tissue and blood.

Yonge (1923), after feeding *Mya* and *Cardium* with dog-fish blood corpuscles, found that they were ingested by phagocytes lying between the epithelial cells in the stomach and ducts of the digestive diverticula. The phagocytes then passed through to the connective tissue, where digestion took place.

Yonge (1926[1]) tried various substances as feeding for *Ostrea :*

1. Iron Saccharate.

This was sometimes ingested in phagocytes lying free in the lumen (very rarely being carried between cells of the epithelium).

2. Blood Corpuscles.

These were ingested by phagocytes. Those not ingested remained in perfect condition. Phagocytes containing ingested corpuscles could be distinguished passing into the stomach epithelium. Digestion in the diverticula, with consequent formation of fat globules, only appeared to take place if phagocytes were present.

Phases of the digestion were as follows :

Three Hours after Feeding.

A few phagocytes in epithelium, and no sign of fat.

Six Hours after Feeding.

Many times more phagocytes in epithelium, with corpuscles now digested and a mass of fat globules. Fat is then passed from phagocytes to epithelial cells, and also transported to the connective tissue ; deposited in vesicular connective tissue cells, but never carried by them to blood vessels.

Two to Three Days Later.

Phagocytes rare.

(The same degree of activity is found in both stomach and in digestive diverticula.)

3. Olive Oil.

After one day phagocytes are found in mantle epithelium, free surface of the visceral mass, gills, palps, and stomach. The gill mucus is full of

phagocytes ingesting the oil which is transformed from neutral fat into fatty acids by the lipase of phagocytes.

The lumen of the stomach contains immense numbers, mostly with ingested oil. In certain cases they collect in great numbers round large droplets of oil, which have turned blue under the influence of the phagocyte enzymes. All drops lying free in the stomach and not surrounded by phagocytes retain their red colour. Phagocytes are seen passing through the epithelium in large numbers.

4. Nitzschia.

Fewer phagocytes were found in the stomach than after feeding with blood corpuscles or oil, but many were in the epithelium and full of fat globules, or green or yellow globules from the chromatophore.

Conditions were essentially the same as with feeding on blood corpuscles.

Yonge therefore concludes that all larger particles, such as oil droplets, blood corpuscles or even small diatoms such as *Nitzschia* are ingested by the phagocytes which abound everywhere in the mantle cavity and gut, but specially in the stomach ducts of digestive diverticula, and mid gut. Particles entering the ducts of the digestive diverticula are seized by phagocytes. Ingested matter is rapidly digested by the phagocytes ; some of the products are passed into the epithelial cells and the remainder carried to the vesicular connective tissue cells (Langer's vesicles) and there stored.

There is no evidence of any absorption in the epithelium of gut or of any free surface of the mantle cavity other than by the agency of phagocytes.

He attributes traces of reducing sugar which are found after incubation with sucrose, maltose, amygdalin, to the activity of the phagocytes which are always present in large numbers in the stomach.

Traces of enzymes which do not proceed from the style (concerned only in carbohydrate digestion) are found in the phagocytes.

In another memoir, Yonge (1926[2]), says that, correlated no doubt with the retention of intracellular digestion throughout the Lamellibranchs is the utilization of phagocytes for the direct ingestion of larger particles than those which can enter the digestive diverticula (whole diatoms are never found in the latter, but are frequently seen in the phagocytes).

They are certainly less numerous in *Nucula* than in higher Lamellibranchs ; while in Gasteropods, where extracellular digestion is better developed, phagocytes do not occur in the gut.

Orton (1923[1]) noted, in *Ostrea* also, the large aggregations of blood cells round the stomach and other parts. All sections of sound oysters show numbers of blood cells round the œsophagus, stomach, intestine, and round most of the gut there are blood channels. He says the bathing of the gut with fluid containing blood cells may certainly be taken as a normal and necessary condition, and there is little doubt that one of the functions of the blood cells is to assist in absorption. (This is corroborated and proved by Yonge's work quoted above.)

Excretion.

Herdman and Boyce (1899) have shown that the blood cells of the oyster contain much copper; and chemical analysis of blood cells (made at Government Laboratories) and other facts indicate that most, if not all, metals in oysters are concentrated in the blood cells (Orton (1923[2])).

Analysis of blood cells from Mylor Bank oysters gave, in one million:

(Approximate)	5180	parts	copper
	8130	,,	zinc
	490	,,	tin
	trace		arsenic.

Other analyses show that the blood cells contain far more metals than oysters analysed as a whole, and particular oysters may contain far greater proportions of metals than has been obtained from analyses of samples of soil taken at the same time. From this Orton concludes that the blood cells of oysters and of other Lamellibranchs are primarily concerned in the segregation and excretion of metals.

In another memoir, Orton (1923[1]), states that there are indications that metalliferous oysters have a much greater quantity of blood cells than other oysters (although there are great variations in the amounts of blood cells in different oysters with differing conditions).

Falmouth oysters, taken from metalliferous beds and transplanted elsewhere, " purify " themselves, i.e., there is a loss of metallic substances. This is a clear indication that excretion of metals from oysters is carried out by the mediation of blood cells.

In such impartially purified oysters there is frequently a mass of green blood cells over the region at the base of the palps, and also green colour around the stomach, due to aggregations of blood cells. Observations on " bleeding " lead to the suspicion that individual blood cells actually leave the body for this purpose.

" Excretion blisters " are found, which are excretory deposits frequently forming from the body of the oyster, inside the shell, and are full of large numbers of blood cells.

Pathological Conditions.

Leucocytosis.

In diseased American oysters Herdman and Boyce (1899) found large quantities of copper in certain green leucocytes. This was accompanied by a most striking increase of leucocytes, which tended to distend the vessels and to collect in clumps. He compared the presence of copper to that of iron in human leucocytes in the cases of old hæmorrhages, pernicious anæmia or in other cases where iron is set free (for the Molluscan blood contains copper as hæmocyanin). He could not decide whether copper was present in the

food, but the oysters may be remote from copper mines or any other source of copper.

Coagulation and Agglutination.

Drew (1910) investigated "clotting" in *Cardium norvegicum* and its relation to the natural cessation of bleeding from a wound and its subsequent healing, and also the chemiotactic action toward cultures of bacteria or extracts of dead tissue. His results showed that some change takes place in corpuscles, when the blood is shed, which causes them to agglutinate round the edges of the wound, and that these masses of corpuscles are connected by thin protoplasmic processes running across the wound. This thickens and contracts and so draws the edges of the wound together.

There is some evidence to show that the change in the corpuscles which causes agglutination is produced by contact stimulus imparted by a foreign body or injured tissues.

On shaking, the corpuscles stick together, forming small white floccular masses. After a lapse of about half an hour many of the corpuscles are fully extended and may then be three or four times their diameter in the contracted state; the pseudopodia are thin and transparent, very long and slender. This spreading out also occurs when fresh blood is stirred with a foreign body or in contact with a rough surface.

When the blood is allowed to flow through a mesh-work of cotton wool, nearly all the corpuscles stick to the strands and form agglutinated masses. (This is not so marked with glass wool.)

If the blood be drawn through a small opening, a clot of corpuscles soon forms which closes the opening and so prevents any further escape of blood.

Sections of a wound left from one to two hours before fixation showed agglutinated masses of leucocytes on the edge of the wound with connecting bands running in all directions, forming a plug.

Sections of wounds a few hours later showed complete blockage by agglutinated corpuscles.

Drew can find no evidence of the nature of the change taking place in the corpuscles, when withdrawn from the animal, which causes agglutination. It is not due either to exposure to the air nor to contact with sea water, because it still occurs when the wound is washed with distilled water. The plasma of Molluscan blood does not coagulate, but Crustacean (*Astacus*) blood undergoes two successive coagulations (Tait and Gunn) :—

(1) Due to cytolysis of the explosive corpuscles.
(2) Due to cytolysis of the thigmocytes.

None follows cytolysis of the amœbocytes.

The thrombin material liberated by a single explosive corpuscle or by a single thigmocyte is capable of coagulating only a limited amount of plasma.

The coagulation products are either long strings of fibrin, or more expanded masses, according to whether it is carried in stream lines by a

current or allowed to diffuse, uniformly and gradually from each source. The contact of blood with non-greasy foreign masses sets up cytolysis in the thrombin-yielding cells. When the blood is kept in fluid paraffin, after removal from the vessels, the cells remain intact and no coagulation occurs.

Kept in a damp chamber, some of the blood cells of *Ostrea* linked up to form open meshworks and chains of cells (Orton (1923[1])). The same phenomenon was observed on the excretory depositions on the shell which were covered by a membrane and calcified.

Orton's interpretation is that the formation of the meshwork is a reaction of blood cells when they come in contact with sea-water (*cf.* Drew, above) outside the body with formation of a plug to staunch the wound, or as scaffolding for subsequent repair.

The blood clot of *Limulus* is a tissue free from fibrin (Loeb (1921)). There is no conversion of fibrinogen into fibrin, no real coagulation in fact, but merely agglutination of blood cells.

Agglutination (*Ostrea*) seems entirely a function of the amœbocytes and not of the blood plasma (Takatsuki (1934)).

. Hollande (1920), remarks, in the larvæ of *Galleria melonella*, in connection with the injection of bacteria (Koch bacillus), that the action of the phagocytes is the same, whether the bacteria are injected alive or after killing by heat: the digestion is accompanied by the appearance of a brownish black pigment. The formation of this pigment also occurs in phagocytes which have ingested inert substances such as carmine, starch, talc, calcium carbonate, etc., and also albuminous substances (egg albumin), precipitated by chemical action or coagulated by heat. The production of the pigment is therefore a function of the diastase action of the phagocytes and not confined to digestion of the Koch bacillus.

In a second memoir he says that the pigment is specially remarkable when the object is too large to be ingested, and is surrounded instead by large numbers of phagocytes forming leucocyte nodules.

His explanation of this reaction is as follows :

The majority of insects, if not all, contain a diastase, closely related to tyrosinase, in the blood. On exposure to air this diastase attacks a chromogenic substance which gradually becomes brownish and then almost black, a melanin. At the moment of phagocytosis the oxidising diastases (peroxidases) of the leucocytes act on the plasma adhering to the foreign body and produce the brown pigment. The melanin seems at first insoluble, but as the process continues in the leucocyte it becomes soluble and diffuses in the blood. Now the pericardium becomes charged with the melanin, at first as brownish vacuoles and then as black masses.

The melanin formed inside the leucocytes exhibits the same reactions to bases, acids, and solvents as those of the melanin observed in the protoplasm of the pericardial cells ; thus both are similar to those of the melanin produced by exposure of the blood to air.

In yeast disease and microsporidial infections of *Gammarus pulex*, Helen Pixell Goodrich (1928) records the behaviour of the leucocytes.

When part of a leg or other appendage is cut off, a plug of leucocytes is formed. Subsequently a yellowish amorphous substance looking like chitin appears at the plug; she suggests that the leucocytes help in the formation of this substance. From examination of sections it seems, according to her, that the chitinous substance is formed chiefly of flattened cells, themselves containing the yellow secretion. Occasionally a few phagocytes containing yellowish refringent globules can be seen on their way to the injured part, but the product only appears in quantity in cells that are already necrotic.

When a host is making headway in dealing with its parasites the phagocytes agglutinate to some extent and deal co-operatively with the yeasts. Aggregations of three or four are frequently seen and attached to their periphery may be other leucocytes without any parasites. Small aggregations like this may be quite colourless and transparent; on the other hand they often contain one or more corpuscles that have already embedded their parasites in a chitinoid secretion. There are, in fact, all stages of aggregations of phagocytes forming nodules. This chitinoid secretion she compares to that produced by the leucocytes at a wound (black or pathological chitin).

In microsporidial infections (*Nosema* and *Thelania*) muscle fibres are occasionally destroyed, they are then usually a mass of spores and the phagocytes attack these and collect into nodular masses owing to the secretion of the usual chitinoid substance.

The secretion of chitin is not due to products of the ingested spores, because injections of indian ink and ammonium carminate were shown to give rise to similar chitinoid nodules.

The chitin produced by the leucocytes is not chemically identical with the true chitin secreted by the epidermis.

Another instance of pigment formation is shown by Thomas (1930) in Nereis. In degenerating oocytes a pigment varying from ochre to mahogany is produced; there are also many amœbocytes round the fragments, filled with pigment. These are undoubtedly phagocytes ingesting the remains of the degenerated oocytes. In connection with degenerating setæ the phagocytes are present too, where there is a similar production of pigment. Oocytes of mahogany colour do not take up vital stains; at the ochre stage the oocytes stain slowly with neutral red (without vacuole formation) and with Nile blue.

He decided that the pigment is not carotinoid nor melanic. It does not stain in sulphuric acid, does not blacken in silver reduction technique, and does not dissolve in alkalis. Its insolubility and stability in the presence of acids and bases, etc., leads him to call it a chromolipoid which can be rapidly oxidised.

(It is not shown whether the pigment occurs in the absence of phagocytes or whether here again it is a result of their activity, *cp.* Hollande, Pixell Goodrich.)

ORIGIN.

Cell Division in Blood.

Tait and Gunn (1918) found one example of mitotic division in antennary blood of *Astacus*, after repeated bleeding, in a hyaline corpuscle. (Mitosis is not uncommon in the blood of Insects.)

Gutheil (1912) observed amitotic division in corpuscles of the gut region *Anodonta*.

Evolution from a Single Type.

Kollmann's (1908) outline of the evolution of the types from the smallest hyaline stage has already been given.

It is possible, according to Tait and Gunn, but not yet satisfactorily proved, that the explosive corpuscles within the blood stream develop into thigmocytes which, by acquisition of granules, become amœbocytes.

Lymph Glands.

These have been demonstrated in very few invertebrates. Pulmonates, Lamellibranchs, Amphineura, Scaphopods, Araneids, Myriapods, and some Insects, Oligochætes, and Gephyreans are all without lymph glands (Kollmann (1908)). There is a localization of lymph tissue in :

Lobster (which has lymphatic nodules in connection with the stomach).

Certain Annelids ; Insects in a small number of abdominal segments in Orthoptera.

Scorpions, Blanchard's gland.

Dorids have a lymphatic gland under the cerebral ganglia.

The greater number of these are lymphogenic ; mitoses are always found.

DISTRIBUTION.

Phagocytes occur throughout the digestive tract and in the hepatopancreatic ducts (both in the epithelium and in the connective tissue) of *Mya arenaria* (Yonge (1923)).

Œsophagus.—Large numbers of phagocytes both in epithelium and connective tissue.

Stomach.—Phagocytes everywhere in the epithelium.

Hepatopancreas.—No phagocytes in the cells of the tubules, but in the epithelium, muscular sheath, and connective tissue they are present in large numbers full of granules.

Mid Gut.—Phagocytes, either empty or with ingested brown particles, are everywhere in the epithelium.

Rectum.—Phagocytes in connective tissue and epithelium.

In *Ostrea*, Yonge (1926[1]), records phagocytes in the following parts :

Gills.—Wandering blood cells are present in large numbers, within the filaments and interfilamentary junctions ; they are also found actually between epithelial cells.

Palps.—Many between the epithelial cells, also present in the connective tissue and blood lacunæ, some containing yellow or brown granules.

Mouth and Œsophagus.—Phagocytes are abundant between the epithelial cells, but also in the lumen, containing ingested matter.

Stomach.—Abundant in the connective tissue, and basement membrane, between the epithelial cells, and free in the lumen.

Digestive Diverticula.—In epithelium and lumen; also in the surrounding connective tissue there are often phagocytes containing brown or yellow spheres which blacken in osmic acid after fixation in Fleming's fixative.

Style Sac.—Everywhere here, but not so numerous in the epithelium of the style sac as in that of the typhlosole where they are exceedingly numerous.

Mid Gut.—Plentiful in and around epithelium and in the lumen.

Lankester (1885) seems to have been the first to note the presence of phagocytes in the gills of green oysters.

De Bruyne (1893) gave a long account of phagocytic cells wandering into the epithelium of gills and mantle in a number of Lamellibranchs.

Gutheil (1912) gives a full account of their presence throughout the alimentary tract of *Anodonta* in the connective tissue and blood-vessels.

Matthias (1914) observed the presence of great numbers in the ventral portion of the stomach of *Arca barbata.*

H. Pixell Goodirch (1928) shows the presence of aggregations of phagocytes in almost any part of the body of *Gammarus*, frequently in the limbs and gills.

Gammarids resemble Decapods among the Crustacea in having special phagocytic organs (" organe phagocytaire hépatique," Bruntz (1907)).

In *Gammarus pulex* the organ consists of a more or less diffuse tissue in close association with the fat body, forming a network over and between the hepatic cæca, alimentary canal and gonads.

Summary.

1. The Invertebrate blood cells show types or stages corresponding with those found in the Vertebrata; but in addition there are types such as the adipo-spherical cells of Annelids and Insects, and the " explosive " cells of *Astacus* and *Ligia*, which do not correspond with anything found in the Vertebrata.

2. Amœboid movement is very common in the invertebrate leucocytes, but all are not amœbocytes with true amœboid movement. The property of thigmotaxis (which is irreversible) is often mistaken for amœboid movement (which is reversible). Phagocytosis and diapedesis are other typical properties.

3. The activities of the invertebrate amœbocytes and allied cells are not confined to phagocytosis and leucocytosis in disease, as are those of the vertebrate leucocytes, but include a large part in digestion and excretion, especially in Lamellibranchs.

4. Coagulation only occurs in some Crustacean blood; the formation of clots in other Invertebrata is purely by agglutination or clumping of the blood cells.

5. In the types studied, phagocytes are widely distributed throughout the body, especially in connection with the digestive organs and in the connective tissue.

6. Lymph glands have been demonstrated only in very few Invertebrates, so that the origin of the amœbocytes and blood cells is obscure ; mitosis is observed in the smaller hyaline type, and the general impression is that other types are developed from this one by the acquisition of granules, etc.

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XIX.—MODIFICATIONS OF MANN'S AND GIEMSA'S STAINS FOR SECTIONS OF RABID MATERIAL

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Many methods of staining have been advocated to demonstrate the presence of Negri bodies in histological sections—the classical method is probably Mann's methyl blue–eosin mixture. It suffers, however, from various defects, especially in the tropics, due, possibly, to poor samples of methyl blue.

Zottner (1934) describes the method as " unfaithful " and in America it has been used with indifferent results.

At this laboratory Mann's method has been in use for some years, as also has Giemsa's method. With the former method results have been by no means constant, and Giemsa for sections frequently gives a picture with an excess of blue and insufficient red staining.

Mann's stain in Nigeria, with our sample of methyl blue (Grübler), stains Negri bodies blue—or at the best mauve. For a long time we had considered our technique faulty, as, of course, Negri bodies should show, at least most of them, a red, or reddish colour with Mann's stain.

We were, therefore, interested to read the excellent work on " Oulou Fato " by the French workers (1933) in West Africa. They also noted that Negri bodies stained blue with Mann's stain.

Various methods have been attempted here to make the Negri bodies stain red with Mann's stain, and the most successful appears to be to stain by the usual Mann's method for about 3 hours at 37° C., wash and treat the sections with pure formalin (40 p.c. formaldehyde) for 5 seconds, then to wash in water and continue as in Mann's method, with alcohol, alkaline alcohol, etc.

Very beautiful results have been obtained by this method, which brings out particularly well the pin-point forms of Negri body. The bodies range from a brilliant eosin colour to, in the case of large bodies of 6μ or more, mauve coloration. The method does *not* lend itself to mounting in acid balsam, and some neutral mountant should be used.

The same formalin treatment has been successfully applied to sections stained by Giemsa, and very beautiful pictures have been noted, providing the section has not been over-stained in Giemsa ; Negri bodies are pale

pink, and most forms show in their centres a small point of blue chromatin. The Giemsa method has been very successfully used also in the demonstration of Rickettsia in brain sections of animals dead from "Heartwater."

Rickettsia stain a brown-red colour by this treatment, and stand out in vivid relief from the small capillaries in the endothelial cells of which Rickettsia can be demonstrated. Decolorization after formol treatment should be carried out with acetone, and not absolute alcohol.

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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(*Under the direction of* G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE.

Rapid Decalcification with Nitric Acid.—G. H. WILSON (*J. Path. and Bact.*, 1934, **39**, 531–2) By using the following method the objection to the use of nitric acid is overcome. Fix thoroughly in 10 p.c. formol saline for from 24 hours to 3 days, according to the size of the specimen. Wash in running water to remove formalin and dehydrate with increasing strengths of alcohol. Transfer to a mixture of equal parts of absolute alcohol and ether for an hour or two, and pass through two changes of ether to remove fat. Pass through equal parts of alcohol and ether, absolute alcohol, and decreasing strengths of alcohol. Wash in running water and transfer to 20 p.c. nitric acid in water, the jar containing the specimen being kept under the air pump till effervescence ceases. Transfer direct to saturated aqueous lithium carbonate and place under the air pump till effervescence ceases, usually a matter of a few minutes. Wash overnight in running water, imbed and section as for ordinary tissues. G. M. F.

Efficient Fat Staining with "Sudan III."—W. W. KAY and R. WHITEHEAD ("The Preparation of Efficient Fat Stains from Insoluble Residues of Weakly Staining Solutions of Commercial 'Sudan III,'" *J. Path. and Bact*, 1934, **39**, 449–55). The staining power of solutions of commercial "Sudan III" in 70 p.c. alcohol was found to decrease rapidly with time. Treatment of the insoluble residues of deteriorated solutions with sulphuric acid ("regeneration") yielded dyes from which staining solutions equal or superior in staining power to freshly made solutions of commercial "Sudan III" could be prepared. Solutions of such "regenerated" dyes in 70 p.c. alcohol might deteriorate rapidly in the same way as solutions prepared from ordinary commercial "Sudan III." Stock solutions of both "ordinary" and "regenerated" "Sudan III" in absolute alcohol were durable, furnishing efficient staining solutions over a period of months. The colour of "Sudan III"-stained sections mounted in glycerine jelly weakened rapidly. The chemical nature and the heterogeneity of commercial "Sudan III" are discussed. G. M. F.

The Impregnation of Microglia with Sulphate of Silver.—T. HORNER and R. PFLEGER ("Sur une méthode d'impregnation de la microglie par le sulfate d'argent," *Compt. rend. Soc. Biol.*, 1934, **117**, 277–9, 1 text-fig.). Material is fixed in 10–15 p.c. formol and may remain in this for a year. Frozen sections are cut at a thickness of 15μ–20μ; the formol is removed by remaining for 24 hours in 100 c.c. of distilled water containing 12 drops of ammonia. The sections are then placed in the bromide mordant of Globus where they stay for 1 hour at 37° C. (a

5 p.c. solution of hydrobromic acid 48·5 of Merck), washed in four changes of 100 c.c. of distilled water and transferred for 1 hour at ordinary temperature to a 5 p.c. solution of sodium sulphate (a.r. of Merck). Sections are passed directly for 5 minutes into an ammoniacal solution of silver sulphate prepared as follows: a graduated tube is first washed with alcohol and a number of times with distilled water; 5 c.c. of a 10 p.c. solution of silver nitrate are mixed with 25 c.c. of the 5 p.c. solution of sodium sulphate. The tube is shaken for 5 minutes and a white chalky precipitate comes down in small granules. The precipitate is dissolved by adding ammonia drop by drop. The amount of fluid is then made up to 50 c.c. The sections are reduced in a 2 p.c. solution of neutral formol; after from 2 to 5 minutes the sections should be the colour of tobacco. Wash, place in a solution of gold chloride (1 in 500); fix in 5 p.c. solution of sodium hyposulphite; wash, pass through alcohols, xylol, and mount in Canada balsam. Sections should have a clear grey colour; only the microglia cells are tinted black. G. M. F.

The Staining of Microglia.—H. A. Barker ("A Modification of del Rio Hortega's Silver Carbonate Method for Microglia," *Lab. J.*, 1934, **7**, 293–4). A small piece of tissue 3 mm. thick is fixed in the following solution: 40 p.c. formaldehyde, 14 c.c.; ammonium bromide, 2 gm.; distilled water, 86 c.c. On the third day frozen sections are cut 25μ–30μ thick and transferred to distilled water. The cut sections are heated in a water bath in fresh formol-ammonium bromide solution at 50°–55° C. for 10 minutes. Sections are then passed through four changes of distilled water, treating with weak ammonia (0·880 ammonia, 0·5 c.c.; distilled water, 99·5 c.c.) between the first and second changes, to remove the formalin. The sections are placed in Hortega's silver carbonate solution for 3 minutes and agitated in 1 p.c. formalin by blowing on them with a pipette. Leave for 1 minute. Wash in distilled water, then tone in gold chloride solution (gold chloride, 1 gm.; distilled water, 500 c.c.) for 5 minutes; transfer to 5 p.c. hyposulphite of soda solution for 1 minute; wash in distilled water, float on the stain and blot gently; pass through alcohol, xylol, and mount in Canada balsam. G. M. F.

Recticulocyte Staining.—R. J. Bromfield (*Lab. J.*, 1934, **7**, 253–5). Clean microscope slides are evenly flooded with a saturated solution of brilliant cresyl blue in ethyl alcohol, the alcohol allowed to evaporate, and the slide finally dried in an incubator. The fine deposit of stain is lightly rubbed on a sheet of glazed paper till a polished surface is obtained, thus removing the larger particles of stain. Two or three drops of blood from an ear or finger puncture are drawn into a capillary pipette and ejected on to the prepared slide. The blood is thoroughly mixed by means of a platinum loop and allowed to stain for from 2 to 5 minutes. A drop of stained blood is taken on the end of a clean slide and a blood film made in the usual manner, and examined under a microscope for reticulocytes. It is best to make films after 2 minutes' staining in order to ascertain how rapidly the cells are staining, as different bloods vary in their affinity for the stain. A properly stained film should appear a deep green colour. Films may be counterstained by Leishman's stain. A limiting stop in the ocular of the microscope facilitates the counting of reticulocytes. G. M. F.

Fixation and Methylene Blue Staining.—E. C. Cole ("An Improved Fixing Solution for Methylene Blue Preparations," *Stain Technol.*, 1934, **9**, 89–90). For tissues stained *intra vitam* a fixative which does not entail any loss of methylene blue is of great importance. An ammonium molybdate solution is prepared as follows: distilled water, 50 c.c.; glycerine, 50 c.c.; ammonium molybdate (hepta)

crystals in excess; concentrated HCl, 15 drops. The solution should be shaken from time to time until saturated with ammonium molybdate; it is then decanted and is ready for use. It may be used repeatedly, and even after standing for several weeks there is no deterioration in fixing power. Tissues, *e.g.* from a frog, stained *intra vitam* with methylene blue are examined under the microscope till staining has progressed to the desired point; then pieces 3 mm. in thickness are placed in the fixing solution for from 30 to 60 minutes. Tissues are washed by soaking in three baths of distilled water, ten minutes in each bath, with shaking.
G. M. F.

Normal Butyl Alcohol for Dehydrating and Clearing Animal Tissues.—K. A. Stiles ("Normal Butyl Alcohol Technic for Animal Tissues with Special Reference to Insects," *Stain Technol.*, 1934, **9**, 97–100). Normal butyl alcohol is substituted for the higher ethyl alcohols in dehydration; no special clearing reagent is necessary as *n*-butyl alcohol is miscible with paraffin. Tissues may be kept without deleterious effects in *n*-butyl alcohol for a year before infiltration, while aphids kept in a hot (58° C.) paraffin bath for as long as 4 weeks have sectioned well.
G. M. F.

The Certification of Stains.—H. J. Conn ("Progress in the Standardization of Stains," *Stain Technol.*, 1934, **9**, 81–8). The chairman of the American Commission on the Standardization of Biological Stains here reviews the progress made since Certification was begun in 1923. At the present time fifty-one stains have been put on a certification basis by the Commission.
G. M. F.

An Alternative to van Gieson's Stain.—J. H. Buzaglo ("Une coloration pouvant remplacer celle de van Gieson," *Bull. d'Histol. appl.*, 1934, **11**, 40–3). The method here described gives a differential staining as good as that of van Gieson's stain and is permanent. Sections are brought down to distilled water and placed in gallocyanine for 5 days (Hollborn No. 2264: ·1 gm. of the dye is boiled for 10 minutes in 100 c.c. of 5 p.c. solution of chromic alum and cooled; water lost by evaporation is restored, and the solution is filtered with a little formalin added to prevent moulds from growing). Rinse twice in distilled water; stain 5 minutes in orceine (1 gm. of Hollborn's No. 2466 Nur für elastische Fasern, dissolved in 100 c.c. of 1 p.c. HCl in 70 p.c. alcohol). Rinse three times in distilled water. Stain 7 minutes in acid alizarine blue (0·5 gm. of acid alizarine blue, Hollborn's No. 2559, boiled 10 minutes in 100 c.c. of a 10 p.c. solution of aluminium sulphate, cooled, evaporated water restored, filtered, and some formalin added). Rinse twice in distilled water. Differentiate 25–30 minutes in 5 p.c. phosphomolybdic acid. Rinse twice. Stain 7 minutes in alizarine-viridine (0·2 gm. of alizarine-viridine Hollborn's No. 2035, dissolved in 100 c.c. of water, acidulated with HCl to *p*H 5·8). Blot with filter paper, pass through the alcohols, carbol-xylol, two xylol baths, and embed in Canada balsam. Results after Susa's, Maximoff's, Hoffker's and formol fixation: nuclei dark blue; elastic fibres brownish-red; muscle and epithelium pale violet blue; collagen, mucus, and cartilage various shades of green; myelin sheaths rose; axial cylinders dark blue; red blood cells brownish-red.
G. M. F.

Staining of Tissue in Bulk with Methylene Blue after Formalin Fixation.—E. Landau ("Coloration des fragments entiers pour les études cytoarchitectoniques," *Bull. d'Histol. appl.*, 1934, **11**, 44–6). After formalin fixation nervous tissue is not easily stained with thionin, methylene blue, toluidine blue, and cresyl violet. The following procedure is recommended: formalin fixed

pieces of nervous tissue (3–4 mm. thick, 1–2 cm. long) are washed in running water for 2 or 3 days; apply filter paper and transfer to equal parts of absolute alcohol and chloroform for 2 days, changing the solution once or twice. Transfer to absolute alcohol for 12 hours, to 70 p.c. alcohol for 6 hours, and to distilled water for 6 hours. Stain 48 hours in a 1 p.c. aqueous solution of toluidine blue or cresyl violet. Wipe with filter paper and transfer for 1–2 days to a 1 p.c. solution of the same dye in creosote, placing calcium chloride on the bottom of the container. Place again in the dye solution for a few hours. Wipe with filter paper and stain with a 1 p.c. solution of the same dye in chloroform in 3–4 hours. Chloroform bath 1 hour; paraffin. Sections are mounted in distilled water; differentiated in absolute alcohol, mounted in xylol and Canada balsam. G. M. F.

Methylene Blue for the Nuclear Structure of Amœbæ.—H. E. McDaniels ("A Simple Stain for Nuclear Structures in Living Amœbæ and Cysts," *Science*, 1934, **79**, 187–8). If a small amount of fæces is emulsified in a drop of water, an equal-sized drop of the stain mixed with the emulsion, and a cover-glass placed on the preparation, cysts and motile forms of amœbæ will stand out as clear refractile bodies in the dark blue field Castor oil and mineral oil droplets in fæces are a light greenish-blue and do not have the clear refractile appearance of cysts. For staining a saturated solution of methylene blue in methyl alcohol is used. The preparations should be thin, and light should be reduced for examination. Chromatin and karyosomes show as clearly under the oil immersion as when hæmatoxylin preparations are examined. G. M. F.

The Staining of the Nerve Elements in Previously Mounted Sections.—L. v. Podhradszky ("Über die Darstellung der Nervenelemente in aufgeklebten Schnitten," *Ztschr. Wis. Mikr.*, 1934, **50**, 285–95). Fix tissues in formol-acetic for from 24 to 36 hours (10 c.c. neutral formalin, 90 c.c. distilled water, 5 c.c. glacial acetic acid). Wash in running water for 24 hours and embed in paraffin. Cut sections about 5μ and mount; dissolve paraffin in benzol, transfer for 30 seconds to ether-alcohol, then submerge in 3–5 p.c. celloidin for 3 minutes. Wipe the celloidin off the under side of the slide and add more upon the sections by dripping, keeping the slides horizontal till the celloidin sets. Before it dries transfer to 80 p.c. alcohol for 10 minutes as this makes the celloidin swell and renders it more porous. Apply the silver nitrate solution (10 gm. $AgNO_3$ in 10 c.c. water, diluted with 96 p.c. alcohol to 100 c.c. with 10–14 drops of N/1 nitric acid added) in darkness for 12 hours at room temperature, and then 30–60 minutes at 37° C.; rinse in 90 p.c. alcohol. Reduce in the following: 5 gm. pyrogallic acid in 100 c.c. of 96 p.c. alcohol, with 5 c.c. neutral formalin; control reduction under the microscope in alcohol, remembering that the final picture will be slightly darker; pass through several changes of 96 p.c. alcohol; if the reaction seems too dark, transfer directly from reducing fluid to ether-alcohol. After removal of celloidin pass through 96 p.c. alcohol, absolute alcohol, xylol and embed in Canada balsam. If desired, the picture may be improved by subsequent gold impregnation. G. M. F.

Staining with Carmine in Bulk.—F. Schwarz ("Untersuchungen über vorteilhafte Stückfärbung mit Karminen," *Ztschr. Wis. Mikr.*, 1934, **50**, 305–22). For staining in bulk the following staining solutions are recommended: (1) Methanolic borax carmine: 4 gm. carmine and 4 gm. borax are boiled in 200 c.c. of water for at least 1 hour till the volume of fluid is reduced to 50 c.c. This solution should not precipitate even when cold; add 50 c.c. of water, then slowly, stirring constantly, 100 c.c. absolute methyl alcohol. Filter after 24 hours. This solution is useful for objects over 1 c.c. in size, for general topography, and for

sections of from 15μ to 40μ in size. (2) Glycerine carmine: add 20 p.c. glycerine to the above borax carmine solution and filter after standing for 24 hours. This solution is useful for small objects to bring out morphological details and for sections of from 10μ to 24μ thickness. (3) Ammonia alum carmine: 1 gm. of carmine and 4 gm. of ammonia alum are dissolved in 150 c.c. of water and boiled down to 75 c.c. Filter while hot. The filtrate is evaporated slowly to dryness and ground to a powder. Dissolve 8 gm. of this powder with gentle heat in 100 c.c. of 40 p.c. methyl alcohol to which 4 drops of concentrated HCl has been added. Filter after 24 hours. This solution is specially valuable for thin sections. They are first stained in glycerine carmine, if large at about 40° C. for ½–3 days. Rinse in 50 p.c. alcohol, differentiate in HCl alcohol, rinse again in alcohol and then stain in ammonia alum carmine, finally rinsing in 35 p.c. alcohol, dehydrating and embedding. G. M. F.

Clearing and Dyeing Fish for Bone Study.—G. HOLLISTER (*Zoologica*, 1934, **12**, 89–101, 4 text-figs.). By this technique it is possible to study the whole of the boney structure of the fish as this is tinted red. Large specimens are fixed in 70 p.c. alcohol for several days, then bathed in distilled water for a few minutes. They are then placed in a solution of KOH varying from 1 to 4 p.c. according to the size of the fish, and afterwards immersed in a solution of alizarin dye 1 c.c. in 1 or 2 p.c. potassium hydroxide 1000 c.c. The alizarin dye is prepared as follows: a saturated solution of alizarin is made up in glacial acetic acid 5 c.c., glycerine 10 c.c., chloral hydrate crystals 1 p.c. 60 c.c. The fish remain in the dye till stained and are next immersed in a clearing fluid of 1–4 p.c. KOH, then to a mixture of KOH containing at least 40 parts of glycerine. Expose to ultra-violet light to aid the clearing; then decrease the amount of KOH and increase the amount of glycerine till chemically pure glycerine, with a trace of thymol, forms the permanent fluid in which the specimen remains indefinitely. G. M. F.

The Staining of Living Sporozoites with Brilliant Cresyl Blue.—A. GIOVANNOLA ("La colorazione vitale degli sporozoiti ed il suo impiego nella diagnosi dell' infettività degli anofeli," *Riv. Malariol.*, 1934, **13**, 327–31, 1 fig.). A solution of 0·5 p.c. brilliant cresyl blue in physiological salt solution is used for staining the salivary glands, which take on a blue colour. The sporozoites which appear mobile and coloured are easily seen. G. M. F.

Cytology.

Golgi Apparatus in the Nerve Cells of the Spinal Ganglia of the Frog.—G. T. DORNESCO and T. BUSNITZA ("Sur la nature de l'appareil de Golgi des cellules nerveuses des ganglions spinaux de la grenouille," *Compt. rend. Soc. de Biol.*, 1934, **117**, 297–300, 6 text-figs.). Kolatchev's method is said to give the only satisfactory results, the Kopsch and da Fano technique being unsatisfactory. The Golgi apparatus is said to be made of a mass of dictyosomes (lepidosome of Parat). G. M. F.

The Cortical Lipoid of the Mouse Suprarenal.—R. WHITEHEAD ("The Cortical Lipoid of the Suprarenal in Mice: (1) with Infectious Ectromelia, (2) in Starvation, (3) Exposed to Heat, and (4) Fed on Cholesterol," *Brit. J. Exp. Path.*, 1934, **15**, 279–86). A lipoid decrease occurred in the suprarenal cortex of mice ill with infectious ectromelia and also in mice starved for 2 days at 13° C., though not in mice starved for 2 days at 37° C. No evidence was obtained that the suprarenal cortex enlarges in cholesterol-fed mice. G. M. F.

The Toxic Action of Cations on the Cells of Various Organs Cultivated in vitro.—C. Sannié and J. Verne (" Étude de l'action toxique des cations sur les cellules de divers organes cultivés *in vitro*," *Compt. rend. Acad. Sci.*, 1934, **199**, 389–91). The toxic action of nineteen cations on the fibroblasts of the chick embryo heart and on the fibroblasts and glandular cells of the liver, kidney, and nervous tissue was studied. Renal epithelium was especially sensitive to lead and copper, liver epithelium to zinc, cobalt, and nickel. Thallium had only a low toxicity for nervous cells. Fibroblasts from different organs showed a different sensibility to the same cation. G. M. F.

Extracellular Protoplasm.—F. K. Studnička (" The Symplasmic State of the Tissues of the Animal Body," *Biol. Reviews*, 1934, **9**, 263–98, 12 text-figs.). In this review, provided with an extensive bibliography, evidence is brought forward to show that the current definition of an animal tissue should be replaced by one comprising all living structures and substances, since " non-cellular " as well as " cellular " tissues exist. The metazoan body is not " composed of cells " as is usually asserted, but besides the cells it contains other protoplasmic structures and masses. These are (1) *syncytia* (for example, a muscle fibre) ; (2) *plasmodia* (whole tissues formed of protoplasm but showing no differentiation into cells) ; (3) intercellular networks formed by cytodesmata, situated between cells or syncytia ; (4) extensive *extracellular cell prolongations* (that is prolongations outside cell bodies, as in the nervous system. Ground substances consist of living matter, at least during their development. A metazoan body is, accordingly, in a symplasmic state in which the living substance is continuous throughout.
G. M. F.

Chromosomal Aberrations.—T. R. Rao (" Chromosomal Aberrations in Unirradiated Grasshoppers," *J. Mysore Univ.*, 1933, **7**, 5–16, 22 text-figs.). There is a great similarity between chromosomal aberrations occurring in nature and those induced by X-rays. Giant spermatids and polyploid cells are frequently observed and are the commonest forms of aberrations. The tetraploid cells occur in all stages of development and exhibit no special features in synapsis. Multiple chromosomes are occasionally formed by the union of two non-homologous rod-shaped bivalents ; either their free ends are directed towards the same pole or they are directed towards opposite poles. Translocation of a segment occurs frequently in the smallest bivalent, resulting in sectional duplication and deficiency. The spermatogonial metaphases in *Orthacris* sometimes show an unusually constricted chromosome, the nature and significance of which are obscure. G. M. F.

Golgi Apparatus of the Adrenal.—G. Bourne (" A Study on the Golgi Apparatus of the Adrenal Gland," *Austral. J. Exp. Biol. and Med. Sci.*, 1934, **12**, 123–39, 59 text-figs.). Golgi preparations were made of the adrenal glands of opossums, young albino rats, and the Australian flying phalanger. Two distinct types of Golgi apparatus were found in the adrenal cortical cells, the compact and the diffuse. The latter is regarded as the hypertrophied form of the compact type. The cells of the zona reticularis possess a Golgi apparatus either in the form of a mass of granules or a condensed black knot closely associated with the nucleus. The zona reticularis is regarded as a zone of degenerating cells. The Golgi apparatus and vitamin C are regarded as being jointly concerned in the production of lipoid material which may be the cortical hormone. G. M. F.

Amœboid Elements in the Blood of Helix.—I. HAUGHTON ("Note on the Amœboid Elements in the Blood of *Helix aspera*," *Quart. J. Micr. Sci.*, 1934, **77**, 157–66, 2 pls.). Clumps of leucocytes of *Helix aspera* may simulate the networks described in tissue cultures. When fragments of the atrium are cut with a sharp knife and mounted as hanging drop preparations in blood, growth or migration occurred in less than 24 hours, but in less than 50 p.c. of the preparations unless the snails were wounded with a needle 4 or 5 hours before removing the heart. The preparations remain sterile up to 6 days (in blood) without special aseptic precautions, probably owing to the leucocytic nature of the cells. The "outgrowths" produced from mantle-wall or other tissues in *Helix* are migrations of leucocytes. It therefore seems that at present it is impossible to differentiate between the various cell elements in blood, in tissue culture, and in such connective tissue networks as are found in the mantle cavity-wall. G. M. F.

Tissue Culture of Helix.—J. BRONTË GATENBY, J. C. HILL, and T. J. MACDOUGALD ("On the Behaviour and Structure of cells of *Helix aspera* in Aseptic and Non-aseptic Tissue Culture," *Quart. J. Micr. Sci.*, 1934, **77**, 2 pls. and 9 text-figs.). An account is given of the techniques used by the present authors and by Premysl Bohuslav (*Arch. f. exper. Zellforssch.*, 1933, vols. **13** and **14**) in dealing with invertebrate tissue culture. In aseptic tissue cultures of the wall of the mantle-cavity of *Helix* the amœbocytes wander out and become much flattened. The pseudopodial membranes of Goodrich are well developed, but intercellular connecting fibrillar pseudopodia are rarer and the outgrowing cells do not organize a connective tissue network to such a degree as in septic mounts. In older explants the Golgi apparatus breaks up into granules which become scattered throughout the cell. In *Helix* tissue cultures, as in flat worms, there is good evidence that cells divide by amitosis. Unlike vertebrate tissue cultures, such as those of chick embryo hearts, the outgrowing cells of *Helix* mantle-cavity ex-plants do not make flat sheets of cells, but tend to form networks, surrounding spaces of a fairly definite size and appearance. The ingestion of bacteria by *Helix* amœbocytes does not occur in the first instance, the cells attacking pigment granules and only later bacteria. G. M. F.

Microincineration Studies on Rat Tumours.—W. C. HUEPER ("Histochemical Studies of Organs of Tumour-bearing Rats by the Micro-incineration Method," *J. Lab. and Clin. Med.*, 1934, **19**, 1293–303, 10 text-figs.). Micro-incineration of two transplantable rat cancers showed that healthy tumour cells contained masses of bluish reflecting granules representing presumably sodium and potassium. Cellular degeneration in these tumours was characterized by an increase of the calcium content of the cells, manifested mainly in the formation of white nuclear rings. The character and composition of the mineral skeleton of the tumour cells could not be changed by the medication of parathormone and viosterol. Degeneration and necroses in the kidney and hearts of rats receiving excessive amounts of parathormone and viosterol were apparently caused by the toxic action of an intracellular calcium accumulation. G. M. F.

The Leucocyte Count from Day to Day.—W. F. HARVEY and T. D. HAMILTON ("Constancy of the Day-to-Day Leucocyte Blood Count—a Medico-statistical Study," *Edin. Med. J.*, 1934, **41**, 465–96, 9 text-figs.). Statistical methods are applied to total and differential leucocyte counts made over some 4 months, one hundred consecutive observations being taken in order to obtain figures of statistical value. The results presented in a series of graphs (daily,

frequency distribution and ogive) serve to show that daily variation of cell counts is not a greatly disturbing factor in regard to their utility; it is, in fact, shown that even a single differential leucocyte count is a very valuable index of body state.

G. M. F.

The Cytology of Experimental Syphilis.—P. D. ROSAHN, L. PEARCE, and A. E. CASEY ("Observations on the Blood Cytology in Experimental Syphilis. I. The Period of Disease Activity," *J. Exp. Med.*, 1934, **59**, 711–20). The mean blood-cell formula of a group of rabbits infected with syphilis was for the $3\frac{1}{2}$ months following inoculation significantly different from the preinoculation mean values observed in the same group in the following respects: higher total white cell count, platelet count, neutrophil count, and monocyte count and lower lymphocyte count. The same differences were observed between the syphilitic group and a normal control group. The changes were statistically significant. P. D. ROSAHN ("Observations on the Blood Cytology in Experimental Syphilis. II. The Period of Disease Latency," *J. Exp. Med.*, 1934, **59**, 721–7). In syphilitic rabbits in which the lesions had undergone spontaneous regression and complete healing the only differences noted from controls were in the red cell count and hæmoglobin content, both of which were significantly lower in the experimental group than the normal values. In human beings after treatment the cell changes are similar to those observed in rabbits.

G. M. F.

Arachnida.

Hydracarina.

A New Eylaid from the Transvaal.—K VIETS ("Eine von Dr. Fritz Haas auf der Schomburgk-Afrika-Expedition 1931/32 gesammelte neue Eylais-Form (Hydrachnellæ, Acari) von Transvaal," *Senckenbergiana*, 1934, **16**, 30–4, 5 text-figs). Describes a new subspecies of *Eylais degenerata* as *transvaalensis*, and lists the already known subspecies of *E. degenerata* with their distribution. Author also comments on Szalay's recent study of the genus.

BM/HNDH

Life-history of Hydrachna nova Mar.—YOSHIAKI MASUDA ("Notes on the Life-history of *Hydrachna* (*Schizohydrachna*) *nova* Marshall," *Journal of Science of the Hiroshima University*, 1934, ser B, Div. I, **3**, 33–43, 2 pls., 5 text-figs.). Gives the results of study during a period of 4 years of the life-history of *Hydrachna* (*Schizo*) *nova* Mar. Very few specimens seem to have been obtained from ponds or swamps, though readily obtainable in various stages in the paddy fields and rice-seed beds, especially the latter. Collections were made during 1928 and 1929 at Gifu, and during 1930–3 at Osaka. The life-history so far as noted does not appear to vary from what is already known. A table is given showing over the period of observation the day to day duration of the various stages. The author writes fluent English, though it is evident at a few points the phrasing is not quite appropriate for what the abstractor feels was intended to be expressed.

BM/HNDH

New Brazilian Water Mites.—K. VIETS ("Neue Hydrachna- und Eylais-Arten (Hydrachnellæ, Acari) aus Porto Alegre, Brasilien," *Zool. Anz.*, 1933, **103**, 161–71, 11 text-figs.). Records new Hydrachna and Eylaid forms in a small collection of water mites made by Prof. Gliesch at Porto Alegre. *Eylais walteri* Lundbl. (*Eylais brevipalpis* Walt.) is recorded, while the new species are *Hydrachna dorsoscutata*, for which the new subgenus *Scutohydrachna* is created, and *H. miliaria brasiliensis* n.subsp. The new Eylaids are *Eylais glieschi*, *E. brasiliensis*, and *E. obliquua*.

BM/HNDH

The North American Species of Hydrachna.—O. Lundblad ("Die nordamerikanischen Arten der Gattung Hydrachna," *Arkiv för Zoologi*, 1934, 28A, no. 3, 1–44, 3 pls., 22 text-figs.). Reviews the genus Hydrachna as known to occur in North America. The type of the genus was for long not satisfactorily determined, notwithstanding Krendowsky's attempt in 1885. Lundblad supports Viets in the view that the most frequently occurring European species of Hydrachna with a large antero-dorsal plate should have Muller's name *cruenta* reserved for it. The Hydrachnas with a large dorsal plate can be separated into two groups, one with slender palpi and the other with stout palpi. The slender palped form appears to be the more widely distributed, and Lundblad proposes to reserve the name *cruenta* for it, while the stout palped form is brought under Koenike's name *schneideri*. A further distinction will be noted, in that the *cruenta* forms have the plate entire, while the thick-palped group have the posterior edge of the plate more or less cut into. As might be expected, a number of the older names fall to be rated as synonyms. Three new varieties appear: *H.* (*H.*) *cruenta* var. *diminuata*, *H* (*H.*) *magniscutata* var. *reducta* and var. *separata*. Four new species are created: *H.* (*Scuto.*) *hutchinsoni*, *H.* (*Diplo.*) *hungerfordi*, *H.* (*Rhabdo.*) *stipata*, and *H.* (*R.*) *hesperia*. The old world *geographica* provides a new form *americana*, while part of Ruth Marshall's *canadensis* has been named *marshallæ*. A new subgenus, *Tetrahydrachna*, covers *H* *miliaria* Berl. BM/HNDH

A New Russian Hydracarid.—Iwan Sokolow ("Eine neue Hydracarinengattung *Rutripalpus* n.gen.," *Zool. Anz.*, 1934, 106, 318–25, 15 text-figs.). The new species *limicola*, taken near Leningrad, has the distinction of not only a new genus *Rutripalpus* being created for it but also a new family, Rutripalpidæ, which takes its place in the system close to the Hydryphantidæ. BM/HNDH

Hydracarina from Asiatic Russia.—Iwan Sokolow ("Résultats scientifiques de l'expédition de l'Académie des Sciences de l'URSS à la Yakoutie—Zur Kenntnis der Hydracarinenfauna von Jakutien," *Travaux de l'Institut Zoologique de l'Académie des Sciences de l'URSS*, 1932, 487–90). Delayed in issue, this communication lists collections of water mites taken by members of the Academy's Expedition in the Governments of Yakutsk and Irkutsck during 1925 and 1926. BM/HNDH

Water Mites from the Springs and Streams of the Baumberge.—K. Viets ("Wassermilben aus den Quellen und Bächen der Baumberge," *Archiv für Hydrobiologie*, 1933, **25**, 661–91, 7 text-figs., 4 tables in text and 2 on insets). Taking as a basis Beyer's study of the creatures inhabiting the rivers and water sources of the Baumberge, Viets discusses the ecological relations of the water mite fauna of that area. The Baumberge are an isolated group of hills in the Westphalian plain to the west of Münster. The main formation is chalk, which gives to the water a certain amount of hardness. The comparative smallness of the mite fauna from these waters is attributed in part to the influence of deforestation of the area on the water sources and to the hardness of the water. The latter acts indirectly on the mites through reducing the flora which affords protection to the mites and the minute creatures which form their sustenance. Three new additions to the German fauna are noted: *Lebertia* (*L.*) *rivulorum* and *Feltria westfalica* n.spp. and *Aturus fontinalis* Lundbl. The water mite fauna, so far as known at present, is considered statistically from various points. BM/HNDH

Protozoa.

A New Marine Rhizopod.—M. W. JEPPS ("On *Kibisidytes marinus*, n. gen., n.sp., and some other Rhizopod Protozoa found on Surface Films," *Quart. J. Micr. Sci.* (n.s.), 1934, **77**, 121–7, 2 pls.). Description of a new testaceous rhizopod found attached to the surface film of marine aquaria. This form, *Kibisidytes marinus* gen.n., sp.n., a small amœboid organism, measuring from 10μ to 14μ, is covered by a pouch-like shell encrusted with some brown material. Its body does not fill the entire space in the shell. The pseudopodia are delicate, branched, and do not extend far outside the opening. No contractile vacuole has been observed. The nucleus contains from one to several staining granules irregularly arranged Multiplication is by binary fission within the shell. The food of the amœba consists mainly of bacteria drawn into the shell. C. A. H.

Locomotion in Amœba.—R. F. PITTS and S. O. MAST ("The Relation between Inorganic Salt Concentration, Hydrogen Ion Concentration, and Physiological Processes in *Amœba proteus*. II. Rate of Locomotion, gel/sol Ratio, and Hydrogen Ion Concentration in Solutions of Single Salts," *J. Cell. and Comp. Physiol.*, 1934, **4**, 237–56, 7 figs.). In this paper are described the mutual relations between the rate of locomotion of *Amœba proteus*, the gel/sol ratio, and hydrogen ion concentration in solutions of sodium, potassium, and calcium salts. As the *p*H decreases the rate of locomotion of the amœba in various concentrations of single salts increases from zero to a maximum, and then decreases to zero again, there being one maximum. In this respect the behaviour of amœba differs from that in mixed solutions of salts, in which there are two maximum rates with a median minimum rate of neutrality. The maximum rate of locomotion observed is highest for potassium and only slightly lower for sodium and calcium solutions. Exposure of amœbæ to solutions of single salts for a period of 4 hours causes injury which is not eliminated in a period of 1 hour in a favourable solution. The extent of injury is inversely proportional to the rate of locomotion in each solution. In Na or K solutions the gel/sol ratio (qualitative measure of viscosity) decreases as the *p*H decreases. In Ca solutions it increases at *p*H 5·9–6·8, then remains constant or decreases. In Na solutions as the salt concentration increases the gel/sol ratio increases from *p*H 5·3 to 5·9 and decreases from *p*H 5·9 to 6·8. In Ca solutions the reverse obtains. There is no specific correlation between sol/gel ratio and rate of locomotion in any of the salt solutions tested. C. A. H.

Vital Staining of the Dysentery Amœba.—E. KITABATAKE ("Studies on *Entamœba histolytica*. I. Vital Staining of *Entamœba histolytica*," *Manshu Igaku Zasshi*, 1933, **18**, 359–75). The author tested 167 dyes for the vital staining of *Entamœba histolytica*. Good results were obtained with neutral red, naphthol blue, vesuvine 4BG, rhodamine B, gelbe AA. C. A. H.

The Structure and Classification of the Peranemidæ.—R. P. HALL ("A Note on the Flagellar Apparatus of *Peranema trichophorum* and the Status of the Family Peranemidæ Stein," *Trans. Amer. Micr. Soc.*, 1934, **53**, 237–43, 14 figs.). The author confirms the previous finding in *Peranema trichophorum* of two flagella, one of which had until recently been overlooked. As this accessory flagellum leaves the gullet it becomes adherent to the periplast and extends posteriorly in a spiral simulating a ridge on the periplast. This second flagellum, being inactive, cannot be recognized as a true flagellum in the living organism. In the course of binary fission each daughter individual receives one of the flagella, while the other

one arises by outgrowth from a blepharoplast. Since Stein's family Peranemidæ is based upon a biflagellate type of structure there appears to be no justification for Calkins' Heteronemidæ, which, therefore, becomes a synonym. C. A. H.

A New Name for Tetramastix.—B. V. Travis (" *Karotomorpha*, a new name for *Tetramastix* Alexeieff, with a Synopsis of the Genus," *Trans. Amer. Micr. Soc.*, 1934, **53**, 277–85, 1 pl., 1 text-fig.). Since the generic name *Tetramastix*, proposed by Alexeieff (1916) for a parasitic flagellate, has been used by Zacharius (1898) for a rotifer, and by Korshikow (1925) for a free-living flagellate, the *Tetramastix* of Alexeieff and of Korshikow are homonyms and must be replaced by new names. *Karotomorpha* is here proposed as *nomen novum* for *Tetramastix* Alexeieff with *bufonis* as the genotype. The diagnosis of the new genus is as follows: flagellates of the order Polymastigida. Body piriform, slender, elongated, tapering posteriorly to a point. Four unequal flagella arise, in two groups of two each, from the anterior end. Spherical nucleus posterior to the basal granules, partly surrounded by large parabasal. Cytostome and axostyle absent. Periplast thick and persistent. Parasites of amphibia. *K. swezi* is differentiated from *K. bufonis*, since its periplast is striated instead of being smooth. C. A. H.

Culture Medium for Cattle Trypanosome.—K. Saizawa, K. Taise, and K. Kaneko (" Studies on *Trypanosoma theileri*," *Jikken Igaku Zasshi*, 1933, **17**, 1–29, 12 figs. (in Japanese)). The authors recommend the following medium for the cultivation of *Trypanosoma theileri*: 7·0 c.c. broth mixed with 3·0 c.c. cattle blood. C. A. H.

Distribution of Intestinal Protozoa in the Rat.—C. A. Kofoid, E. McNeil, and A. Bonestell (" Correlation of the Distribution of the Protozoa in the Intestine of *Rattus norvegicus* with the Hydrogen Ion Concentration of the Intestinal Contents and Wall," *Univ. Calif. Pub. in Zool.*, 1933, **39**, 179–90, 3 figs.). The presence and proportion of various protozoa in the different parts of the intestine of *Rattus norvegicus* was found to be correlated with the *p*H of the intestinal walls and contents. *Trichomonas* occurred in the cæcum of all rats examined, in the ileum of 40 p.c. and in the colon of 80 p.c. There is a correlation between the decrease in numbers of this flagellate in the upper ileum and the decrease of *p*H in that region. *Hexamitus muris* was present in the duodenum of 17 p.c., in the jejunum of 7 p.c., and the cæcum of 3 p.c. of the rats. This parasite requires a *p*H range of 5·98–8·27. *Chilomastix bettencourti* was found in the cæcum of 60 p.c. of the rats at an average *p*H 6·77, and in the colon of 8 p.c. of cases. *Giardia* was present in 60 p.c. of the rats, in close proximity to the wall. This flagellate occurs primarily in the jejunum between *p*H 6·45 and 6·52. Motile amœbæ were present in 70 p.c. of the rats examined, at an average *p*H of 6·7. C. A. H.

The Nomenclature of Eumonospora.—E. A. Allen (" *Eumonospora tremula* (Allen, 1933) amended to *Caryospora tremula* (Allen, 1933) Hoare, 1934," *Trans. Amer. Micr. Soc.*, 1934, **53**, 293.) In this note the author accepts Hoare's interpretation of the systematic status of the coccidium *Eumonospora tremula*, the correct name of which is *Caryospora tremula* (Allen, 1933) Hoare, 1934. [*Cf.* abstracts in *J.R.M.S.*, **53**, p. 341; and **54**, p. 127.] C. A. H.

Transmission of Human Malaria to Monkeys.—(i) W. H. Taliaferro and L. G. Taliaferro (" The Transmission of *Plasmodium falciparum* to the Howler Monkey, *Alouatta* sp. I. General Nature of the Infections and Morphology of the Parasites"). (ii) W. H. Taliaferro and P. R. Cannon (" *Idem.*

II. Cellular Reactions ") (*Amer. J. Hyg.*, 1934, **19**, 318–42, 3 pls.). Description of the results of experiments on the artificial infection of howler monkeys, *Alouatta* sp., with the parasites of human malignant tertian malaria, *Plasmodium falciparum*, The study involved inoculations from nine human cases into nine young monkeys. none of which was infected with monkey malaria (*P. brasilianum*). From 15 to 20 c.c. of infected human blood were diluted with four times this volume of 0·4 p.c. citrate and centrifuged. The precipitate of red cells was mixed with an equal volume of saline, so that the infecting dose amounted to 7–10 c.c., and was inoculated into the tail of a monkey. Successful infection was obtained in all but two of the monkeys. The longest infection lasted 8 days in one monkey; the most intense infection encountered in another monkey was 915 parasites per 10,000 red cells; in other monkeys the infections were extremely transitory. The parasite in the monkey was morphologically indistinguishable from *P. falciparum* in man and its cycle of reproduction (48 hours) was identical, though no crescents were found. The parasites were concentrated chiefly in the spleen, and also in the liver and bone-marrow. C. A. H.

Bartonella and Its Allies.—W. Kikuth (" The Bartonella and Related Parasites in Man and Animals (Oroya Fever and Verruga Peruviana)," *Proc. Roy. Soc. Med.*, 1934, **27** (Sect. Trop. Dis. and Parasitol, pp. 57–65)). This is a critical review of the present state of our knowledge regarding a group of micro-organisms parasitic in the blood, which includes *Bartonella, Eperythrozoon, Grahamella*, and some others, together with an account of the diseases produced by some of these parasites. C. A. H.

Transmission of Anaplasma.—C. W. Rees (" Transmission of Anaplasmosis by Various Species of Ticks," *U.S. Dept. of Agric. Tech. Bull*, no. 418, 1934, 17 pp.). The author has demonstrated that anaplasmosis can be transmitted by the following ticks: *Dermacentor andersoni, D. variabilis* (the genus *Dermacentor* being incriminated for the first time), *Rhipicephalus sanguineus*, and *Ixodes scapularis*. In all these ticks transmission was non-hereditary, with an incubation period from 30 to 60 days, while hereditary transmission occurred only in *Boophilus annulatus*. C. A. H.

Mendelian Heredity in Paramæcium.— T. M. Sonneborn and R. S. Lynch (" Hybridization and Segregation in *Paramecium aurelia*," *J. Exp. Zool.*, 1934, **67**, 1–72, 10 figs.). Description of a study of the results of conjugation between genetically diverse stocks of *Paramæcium aurelia*. Hybrid clones exhibited characters intermediate between those of the parent clones or between those of the two groups of clones obtained by inbreeding the parent clones. Hybrid clones are of two types differing in the origin of their cytoplasm and macronuclear fragments: one type derives these from one parent clone, the other type from the other one taking part in the cross. One hybrid clone of each type arises from each pair of hybrid exconjugants. Among the cytoplasmic descendants of either parent clone, those descended through inbreeding differed from those descended through cross-breeding, the latter resembling to some extent the non-cytoplasmic parent. The two types of hybrids were both intermediate. The definitive characteristics of different hybrid pairs from the cross of the same two parent clones were diverse, some pairs resembling one parent, some pairs the other one, while others were intermediate. When hybrids of either type of cytoplasmic descent were inbred, in the resulting F2 generation the clones showed the same three varieties of characteristics. When such F2 segregates were further inbred

the F3 generation showed that some F2 segregates were pure, while others were mixed in genetic constitution. The results indicate that the usual mendelian situation, modified in some details, exists in paramæcium. C. A. H.

Endomixis and Variation in Paramæcium.—L. CALDWELL ("The Production of Inherited Diversities at Endomixis in *Paramecium aurelia*," *J. Exp. Zool.*, 1933, **66**, 371–407, 1 fig.). The author records observations on the production of inherited variations at the time of endomixis in an inbred stock of *Paramœcium aurelia* derived from a single individual and cultivated for three years. It was found that under these conditions certain clones produced many non-viable lines, while some lines were differentiated at endomixis into viable and non-viable descendant lines. On the other hand, some clones underwent endomixis with undiminished vitality and without deaths in any of their branches. In some cases endomixis leads to a variation in the fission rate in successive lines, which may be above or below the normal rate. The most common tendency is for endomixis to lower the fission rate, some of the lines dying out within a few generations, while others survive the next period of endomixis. In others, again, the lowered fission rate is maintained indefinitely. In one case endomixis resulted in the appearance of a distinct biotype differing from the original stock in many morphological and physical characters. The general result of the observations is to demonstrate the frequent occurrence of heritable variations at endomixis.
C. A. H.

Two New Genera.—HELEN J. PLUMMER ("*Epistominoides* and *Coleites*, New Genera of Foraminifera," *Amer. Mid. Naturalist*, 1934, **15**, no. 5, 601–8, pl. xxiv, 1 text-fig.). Two rather rare species of Foraminifera diagnostic of Midway strata in Texas were originally described from insufficient material to permit a full and accurate understanding of their structure. *Pulvinulina reticulosa* Plummer, 1927, was described from a single specimen of which the terminal aperture was obscured by extraneous matter. It now becomes the genotype of *Coleites* in the same family. *Saracenaria wilcoxensis* Cushman and Ponton, 1932, is removed from the Lagenidæ to the Rotaliidæ and becomes the genotype of *Epistominoides*, its structure being closely related to that of *Epistomina*. Another new species, *Epistominoides midwayensis*, is also described from Midway (Eocene) strata. A. E.

Late Tertiary Foraminifera from Fiji.—J. A. CUSHMAN ("Smaller Foraminifera from Vitilevu, Fiji," *Bernice P. Bishop Museum*, Bull. 119, 1934, 102–42, pls. 10–18). The material was from two localities, near Suva, Fiji, taken at elevations of 10 and 550 feet. They are apparently of identical age, probably Pliocene, and represent raised *Globigerina* oozes, the species indicating depths of about 100–250 fathoms. It is assumed that the two deposits were laid down contemporaneously, and the difference in their present levels confirms this. The more elevated deposit was obviously laid down in much shallower water than the deposit from near sea-level, as indicated by the presence of heavy species of *Textularia*, *Gaudryina* and *Clavulina*, while the less elevated deposit is marked by the abundant *Lagenæ* and *Nodosariæ*, inhabitants of deeper water. Brady described a very similar fauna from the "soapstone" of Fiji in 1888, listing ninety-two species and varieties. The fact that fifty-six of these are recorded in the present paper out of a total of 118 species and varieties, and that thirty-nine of these "Brady" forms were found in the less elevated deposit, is proof that Brady's material was similar to that from the deeper and less elevated deposit. A number of new species and varieties have already been described and figured (*Cont. Cush.*

Lab. For. Res., 1931, no. 103, 25–32, pl. iv.) to avoid the delay in publication of this report. Certain of the species, such as *Ehrenbergina bicornis* Brady, are known only from Brady's original record, and others only from Schwager's monograph on the Pliocene of the Nicobar Islands. The fauna in general, however, is widely distributed in the late Tertiary deposits of the Indo-Pacific region, and most of the species are still living in the same area. There is an interesting table comparing the faunas of the two deposits with those of the three samples reported on by Brady. The plates are good. A. E.

Eocene Foraminifera from California.—J. A. CUSHMAN and A. N. DUSENBURY, Jr. ("Eocene Foraminifera of the Poway Conglomerate of California," *Cont. Cush. Lab. For. Res.*, 1934, no. 145, 51–65, pls. 7, 8, and part 9). The material from Murray Canyon near San Diego, California, consisted of a large fossiliferous lens of fine-grained shaly sandstone found in a deltoid marine conglomerate. The Foraminifera include a large proportion of Lagenidæ, and the majority of the species were originally described from the Middle and Upper Eocene of the Gulf and Pacific coasts of the United States and Mexico. Thirty-five species and varieties are described and the more important are adequately figured. Four new species are figured and described. A. E.

Three New Species.—J. A. CUSHMAN and J. B. GARRETT, Jr. ("New Species of *Triloculina* from the Claiborne of Louisiana," *Cont. Cush. Lab. For. Res.*, 1934, no. 146, 65–70, figs. on pl. ix.). Figures and describes three very decorative species from the Eocene of Louisiana. A. E.

Another New Species of Spiroplectoides.—J. A. CUSHMAN and A. S. CAMPBELL ("A New *Spiroplectoides* from the Cretaceous of California," *Cont. Cush. Lab. For. Res.*, 1934, no. 147, 70–71, figs. on pl. ix.). *Spiroplectoides californica* is a large species which is regarded as likely to be a distinct zone fossil for the Chico of California (Upper Cretaceous). It is nearly always found associated with *Silicosigmoilina californica* a common fossil of the Chico. Its nearest ally is apparently *S. clotho* (Grzybowski), but the microspheric form is not so definitely lance-shaped. As the wall is described as siliceous, it seems doubtful whether the species should not really be referred to *Spiroplectammina*. (See abstract on the genus *Spiroplectoides* on p. 205 of this Journal, September, 1934.) A. E.

New Fossils from Trinidad.—J. A. CUSHMAN and P. W. JARVIS ("Some Interesting New Uniserial Foraminifera from Trinidad," *Cont. Cush. Lab. For. Res.*, 1934, no. 148, 71–5, pl. x.). Three new species and a new variety of *Ellipsonodosaria* and four new species of *Chrysalogonium* are described and figured from the Lower Miocene of Trinidad. A. E.

Ultramicroscopic Viruses.

The Virus and the Inclusion Bodies of Silk-worm Jaundice.—R. W. GLASER and C. W. LACAILLADE, Jr. ("Relation of the Virus and the Inclusion Bodies of Silkworm 'Jaundice,'" *Amer. J. Hyg.*, 1934, **20**, 454–64). When freshly drawn jaundice blood, containing polyhedral bodies, is immediately centrifuged, the supernatant fluid freed from the inclusions is very active. If infectious blood is allowed to stand for some time the inclusion bodies settle and in the upper layer of the fluid which is free from them, no virus is found. The polyhedra continuously lose virus when washed in water but cannot be freed from the

infective agent in this manner. The polyhedra cannot be freed from virus by the use of certain chemicals. The inclusions are evidently physical carriers of the virus, but are not regarded as ætiologically important in the sense of a genetic relationship. G. M. F.

The Development of the Psittacosis Virus.—S. P. Bedson and J. O. W. Bland ("The Developmental Forms of Psittacosis Virus," *Brit. J. Exp. Path.*, 1934, **15**, 243–7, 4 text-figs.). It is shown that the apparently homogeneous virus masses seen in the early stages of multiplication of psittacosis virus are particulate. The virus is thus a micro-organism with bacterial affinities and is essentially an intracellular parasite which in the early stages of multiplication produces forms much larger than the normal. The names *Microbacterium multiforme psittacosis* and *Rickettsia psittaci* are criticized. G. M. F.

Studies on B Virus.—A. B. Sabin ("I. The Immunological Identity of a Virus Isolated from a human Case of Ascending Myelitis associated with Visceral Necrosis. II. Properties of the Virus and Pathogenesis of the Experimental Disease in Rabbits," *Brit. J. Exp. Path.*, 1934, **15**, 248–79). Anti-B virus and anti-herpes sera were obtained which neutralized either one or the other virus exclusively, and qualitative tests with moderate doses of virus revealed no active cross-immunity between the two viruses. Quantitative neutralization tests as well as titrations on actively immune animals, however, revealed a partial immunological relationship between B virus and herpes. A partial immunological relationship was also found to exist between B virus and pseudorabies. No relationship was found between B virus and Virus III or vaccinia. B virus is therefore regarded as an immunologically distinct and specific filterable virus with a group relationship to herpes and pseudorabies. In rabbits intravenous inoculation is followed by the development of necrotic foci in the liver, spleen, and adrenals and a terminal myeloencephalitis. Guinea-pigs may be infected, but the virus is only irregularly fatal even after intracerebral inoculation. G. M. F.

Epidemic Tremor, a New Virus Disease of Chickens.—E. E. Jones ("Epidemic Tremor, an Encephalomyelitis affecting Young Chickens," *J. Exp. Med.*, 1934, **59**, 781–98, 2 pls.). A new disease is described in young chickens in four New England states. Tremor, principally of the head and neck, and progressive ataxia are the characteristic symptoms, either or both of which may be present in a single bird. Age at onset in field epidemics ranges from 3 days to 6 weeks with an average of 3 weeks. Mortality may be 50 p.c. The disease has been reproduced in normal chickens by intracerebral inoculation of brain and spinal cord from affected birds, the incubation period ranging from 6 to 44 days, with symptoms usually appearing between 21 and 28 days. The infective agent has survived in 50 p.c. glycerine for 69 days; no organism has been cultivated. The disease has been reproduced after inoculation with bacteriologically sterile filtrates obtained with Seitz and Berkefeld N filters. The characteristic lesions throughout the brain and cord are collections of glia cells, perivascular infiltration, degeneration of Purkinge's cells, and degeneration of nerve cells. In the viscera are focal infiltration of lymphoid cells most noticeable in the pancreas and heart. No cell inclusions have been demonstrated. G. M. F.

Intranuclear Inclusions and Neoplastic Disease in the Frog.—B. Lucké ("A Neoplastic Disease of the Kidney of the Frog, *Rana pipiens*," *Amer. J. Cancer*, 1934, **20**, 352–79, 27 figs.). In the kidneys of 158 frogs of the species *Rana pipiens* a neoplastic disease occurs characterized by solitary or multiple ivory-

white tumours; histologically they are composed of atypical epithelial cells, grouped around spaces, and resembling an adenocarcinoma. The growths are locally destructive and infiltrate the adjacent kidney. In only one case has a tumour been found to produce secondary metastases in the liver. In a large proportion of the tumours the cells contain prominent acidophilic intranuclear inclusions. Transmission experiments were inconclusive. G. M. F.

Experimental Mumps.—G. M. FINDLAY and L. P. CLARKE ("The Experimental Production of Mumps in Monkeys," *Brit. J. Exp. Path.*, 1934, **15**, 309–13, 1 pl.). The experimental production of mumps in rhesus monkeys by direct inoculation into Stensen's duct recorded by Johnson and Goodpasture (*J. Exp. Med.*, 1934, **59**, 1) in America is confirmed. The histological changes consist of degenerative lesions in the acinar cells of the parotid gland and an infiltration with mononuclear cells. There is also a leucopenia. The virus has been passaged six times in monkeys. Injection of the virus into the tunica vaginalis of monkeys causes a non-suppurative orchitis. G. M. F.

The Elementary Bodies of Herpes zoster.—C. R. AMIES ("The Elementary Bodies of Zoster and their Serological Relationship to those of Varicella," *Brit. J. Exp. Path.*, 1934, **15**, 314–20). Stained films prepared from vesicle fluid of herpes zoster revealed the presence of elementary bodies which were present in large numbers in the fluid removed 24 to 48 hours after the onset of vesiculation. At later stages the number of bodies progressively decreases and inflammatory cells, mainly mononuclear in type, make their appearance. Any of the methods employed for staining elementary bodies, such as Giemsa or Ziehl Neelsen's carbol fuchsin preceded by Loeffler's mordant may be used for demonstrating zoster bodies, but the method which gave the best results was the use of Cæsares-Gil's mordant of fuchsin in the cold, as recommended for flagella staining by Plimmer and Paine (*J. Path. and Bact.*, 1921, **24**, 286). Pure suspensions of these bodies, prepared by high-speed centrifugation of zoster vesicle fluid are specifically agglutinated by zoster convalescent sera, while efforts to demonstrate the relation of zoster and varicella by means of cross-agglutination tests met with fair success.
G. M. F.

Cell Inclusion Disease of Fowls.—S. J. GILBERT and G. B. SIMMINS ("Further Observations on Cell Inclusion Disease of Fowls and Differential Diagnosis from Fowl Plague," *J. Comp. Path. and Therap.*, 1934, **47**, 201–4). This disease of fowls, originally described by the writers in 1931, (*J. Comp. Path. and Therap.*, 1931, **44**), bears some resemblance to fowl plague, but differs from it owing to the presence of distinct inclusions in the leucocytes. It is also known to exist in a chronic form, and is sometimes so slight as to pass unnoticed. There are lesions in the liver and as a rule an absence of bowel changes. G. M. F.

Pustular Stomatitis of Sheep.—G. BLANC and L. A. MARTIN ("La stomatite pustuleuse contagieuse des ovins: étude expérimentale d'une souche marocaine," *Arch. Inst. Pasteur du Maroc*, 1934, **1**, 171–96, 10 figs.). The histological changes in the skin of sheep, dogs, and monkeys are described. The Malphighian layer of the epidermis is specially affected, the cells swollen and vesiculated. The capillaries in the dermis are very congested. The virus can be found in the brains of sheep inoculated into the skin. Man reacts with a few papules only; there is no cross immunity with vaccinia. Intracerebral inoculation in rabbits produces an encephalitis. G. M. F.

A New Virus from St. Louis Encephalitis.—C. Armstrong and R. D. Lillie ("Experimental Lymphocytic Choriomeningitis of Monkeys and Mice produced by a Virus encountered in Studies of the 1933 St. Louis Encephalitis Epidemic," *Publ. Health Reports*, 1934, **49**, 1019–27). A strain of virus obtained from what appeared to be a typical case of St. Louis encephalitis began to show peculiarities after six passages in monkeys. In addition to rhesus monkeys and mice, cebus monkeys and guinea-pigs are susceptible to the choriomeningitis strains, while these last two species are refractory to encephalitis strains. The incubation period in monkeys is from 4 to 10 days, while with encephalitis strains it is from 8 to 14 days ; in white mice the reverse is true, 6–9 days as compared to 4–8 days with the encephalitis virus. Cross-neutralization tests indicate that the viruses are immunologically distinct. The choriomeningitis virus fails to produce detectable symptoms in mice when introduced intranasally. The pathology produced by the two viruses in mice and monkeys is readily distinguishable. In monkeys there was diffuse and irregular cellular infiltration of the meninges, generally composed of small lymphocytes ; swelling, œdema, and lymphocytic infiltration of the choroid plexus was noted. G. M. F.

The Morphogenesis of Negri Bodies.—S. Nicolau and L. Kopciowska ("Étude sur la morphogénèse des corps de Negri," *Ann. Instit. Pasteur*, 1934, **53**, 418–37, 22 figs.). The various phases in the formation of Negri bodies are agglutination of the Nissl granules, flocculation of the agglutinated granules, which form masses of varying dimensions and contain chromatin material, rounding of the contours of the masses which are still slightly basophil, transformation into oxyphilic formations. The Negri bodies are defence reactions of the cell. When inclusions appear in the cell, the morphology and staining power of the cell is retained, but if Negri bodies are not formed the virus invades the cell completely, and degeneration and necrobiosis result. G. M. F.

Rabbit Pox.—H. S. N. Greene ("Rabbit-pox. II. Pathology of the Epidemic Disease," *J. Exp. Med.*, 1934, **60**, 441–56, 3 pls.). An infection among rabbits originated in the Rockefeller Institute, New York, and reached the breeding colony as a clearly defined epidemic infection. The disease resembled smallpox in man. The most distinctive gross lesion in all organs and tissues was the small nodule or papule which was found to consist of mononuclear infiltration and necrosis. Diffuse lesions, associated with œdema, hæmorrhage, and extensive necrosis were also encountered. Primary endothelial damage, corresponding to the extent of the lesion, was found in the small blood-vessels. No inclusion bodies were seen. G. M. F.

The Pathology of the St. Louis Type of Encephalitis.—H. A. McCordock, W. Collier, and S. H. Gray ("The St. Louis Type of Encephalitis," *J. Amer. Med. Assn.*, 1934, **103**, 822–4, 6 text-figs.). Congestion of the meningeal or intracerebral blood-vessels was found in all cases, and in some there were small subarachnoid hæmorrhages, petechial hæmorrhage in the brain substance, or an occasional extravasation of blood into a perivascular space. Perivascular accumulations of lymphocytes were common, but in addition there were inflammatory collections of cells made up of microglia with a few plasma cells and polymorphonuclear leucocytes. In three-fourths of the cases there was an infiltration in the meninges. Nerve-cell degeneration was common, often associated with hypertrophic acidophilic nucleoli. No true intranuclear inclusions were seen in the central nervous system. Neuronophagia was marked. In one-fourth of the

kidneys examined intranuclear inclusions were found in the epithelial cells of the convoluted tubules of Henle's loop. The lesions were very similar to those seen in type B encephalitis in Japan. G. M. F.

Cultivation of the Virus of Lymphogranuloma inguinale.—J. T. TAMURA (" Cultivation of the Virus of Lymphogranuloma Inguinale and its use in Therapeutic Inoculation: Preliminary Report," *J. Amer. Med. Assn.*, 1934, **103**, 408–9). Pus is removed aseptically from a bubo and is diluted 1 in 5 with sterile saline solution. From 0·02 to 0·03 c.c. of the diluted pus is planted in Tyrode's solution, containing a piece of guinea-pig kidney or liver and incubated at 37·5° C.; a peculiar cloudiness appears throughout the supernatant liquid in from 36 to 48 hours; the cloudiness can be transmitted from tube to tube, twenty-four subcultures having been made. The virus will pass through a Berkefeld N filter and is pathogenic for guinea-pigs. G. M. F.

Mineral Constituents of the Anterior Horn Cells in Poliomyelitis.—W. E. PATTON (" Alterations in Mineral Constituents of Anterior Horn Cells in Experimental Poliomyelitis," *Amer. J. Path.*, 1934, **10**, 615–28, 1 pl.). The principal type of nerve-cell destruction in poliomyelitis involves three stages: œdema. with acute swelling of the cell and diminution of its inorganic content; granulation, with hypermineralization of the cytoplasm; and acidophilic necrosis, with diminution of mineral constituents. G. M. F.

Inclusion Bodies in Mice and Rats.—J. THOMPSON (" Inclusion Bodies in the Salivary Glands and Liver of Mice and Rats," *Amer. J. Path.*, 1934, **10**, 676–7). In the mucous acini of the submaxillary glands in both mice and rats large inclusion-containing cells were found in a considerable number of animals. The histological appearance had many features in common with the inclusions associated with guinea-pig submaxillary virus disease. In a considerable number of cases unusual intranuclear changes were also observed in the acinar cells of the facial portion of the parotid glands of apparently healthy rats and in the hepatic cells of seemingly normal mice. G. M. F.

Intranuclear Inclusions in Moles.—E. J. RECTOR and L. E. RECTOR (" Intranuclear Inclusions in the Salivary Glands of Moles," *Amer. J. Path.*, 1934, **10**, 629–36, 1 pl.). In the cells of the salivary glands of fourteen moles intranuclear inclusions were found either in the terminal tubules of the serous portions of the glands or more rarely in the mucous parts; none were found in duct cells. The inclusion-containing cells and nuclei were very hypertrophied. The inclusions were basophilic, only rarely showing any tendency towards acidophilia; they gave marked Feulgen and masked iron reactions. In the cytoplasm of most cells ten to thirty small basophilic inclusions were closely visible, resembling those described in the guinea-pig's submaxillary glands by Pearson (*Amer. J. Path.*, 1930, **6**, 261). Margination of basophilic chromatin on the nuclear membrane was absent or slight. The nucleoli do not contribute towards the formation of the inclusions. Attempts to demonstrate the presence of a virus by intracerebral inoculation in rabbit, rat, and guinea-pig were unsuccessful. G. M. F.

BOTANY.

(*Under the direction of* A. B. RENDLE, M.A., D.Sc., F.R.S)

Cytology.

Fertilization in Crepis.—HELEN GERASSIMOVA ("Fertilization in *Crepis capillaris*," *La Cellule*, 1933, **42**, 103–48). The fertilization of *Crepis capillaris* is described in detail and accompanied by fifty-one figures. The strongly curved, wormlike sperms are ejected into the embryo-sac about fifty minutes after pollination. Before fusing with the female nuclei the sperms pass through a series of definite and characteristic changes in shape and structure. These alterations are considered necessary maturation stages which can only be passed through under the conditions within the embryo-sac. The two sperms are identical and undergo the same changes. Complete mixing of male and female chromatin occurs very soon after penetration of the egg-nucleus by the sperm. The egg is fertilized earlier than the two polar nuclei. Abnormalities regarding the number of gametes, both male and female, within an embryo-sac are recorded. Their origin was not established. Supernumerary eggs and sperms degenerate. Cases were observed where an embryo developed without any endosperm formation, and where endosperm formed in the absence of an embryo. The non-functioning sperm in such cases was always seen lying in the upper part of the embryo-sac. Pollen-tubes of *Crepis tectorum* grow rapidly in the style of *C. capillaris*. The alterations in the sperms within the embryo-sac are alike in the two species. Failure to obtain 100 p.c. fertilized eggs in crosses of these two species is due to inability of some sperms to fuse and not to inability of the pollen-tube to grow on a foreign stigma.

J. S.

Gametogenesis and Fertilization in Scilla.—GLADYS V. HOARE ("Gametogenesis and Fertilization in *Scilla nonscripta*," *La Cellule*, 1934, **42**, 269–91). The development of the microsporangium and megasporangium is described, also nuclear division in the pollen-grain and its germination, the development of the embryo-sac, fertilization, and the early divisions in the embryo and endosperm. The megaspore-mother-cell divides into two cells, the upper becoming the eight-nucleate embryo-sac and the lower forming four nuclei which appear active till after fertilization. Nuclear divisions in the female gametophyte are usually later than the corresponding divisions in the male. At fertilization the egg-nucleus is usually resting, while the male is in a condition appearing like late prophase, but which is really the previous early telophase. The thick threads of the male nucleus are at first quite distinct, but gradually become thinner till male and female cannot be distinguished and the fusion nucleus rests for a time. The polar nuclear unite but do not fuse. The second male nucleus fuses with one polar nucleus, the stages of fusion resembling the fertilization of the egg. The fertilized polars enter prophase after a short resting period. The three chromosome groups are quite distinct even at the seventh division, and it is therefore presumed that they never mingle during the nuclear divisions of the endosperm. At the division of the

fertilized egg the male and female chromosomes become mingled at the first telophase and there is no evidence of grouping in any later divisions. The work is discussed in relation to that of other investigators. J. S.

Pollen Development in Gentiana.—Wóycicki, Z. ("Quelques détails du développement des anthères et du pollen chez certains représentants du genre *Gentiana*. 1. *Gentiana asclepiadea L.*," *Acta Soc. Bot. Poloniæ*, 1932, **9**, 7–30). Polish with French summary. Surrounding the archesporial cells in the anthers of *Gentiana asclepiadea* are some very elongated cells in addition to the normal tapetum. All these surrounding cells take part in the formation of the periplasmodium of the pollen-grains. The periplasmodium is at its maximum development during the early growth of the free grains, and later degenerates. The rounding off of the pollen-mother-cells in the archesporium is accompanied by contraction of the protoplast and the production from it of an envelope of callus. This process occurs again at the division into tetrads, cytokinesis being brought about by furrows of callus formed from the periphery. The free pollen-grains show three protuberances each containing a large vacuole and marking the point of origin of the germ-pores. The haploid chromosome number is probably 16. Up to the time of degeneration of the periplasmodium there is no trace of fibrous tissue in the subepidermal layer of the anthers. J. S.

Pollen Development in Gentiana.—Wóycicki, Z. ("Quelques détails du développement des anthères et du pollen chez certains représentants du genre *Gentiana*. II. *Gentiana Fetisowi* Rgl. et Winkler," *Acta Soc. Bot. Poloniæ*, 1933, **10**, 1–24). Polish with French summary. The semicircular pollen-sacs of *Gentiana Fetisowi* are traversed occasionally by layers of cells extending from the inner to the external tapetum. Usually only two or three stamens of a bud develop normally while the others show varying degrees of pathological phenomena of either archesporium or tapetum. Normal development of the pollen-grains is as in *G. asclepiadea* (1932) with a similar method of quadripartition of the mother-cells. The callus envelopes disappear when the periplasmodium forms from the tapetum. Unfused nuclei in the periplasmodium contain twenty-eight to thirty distinct chromocentres. The nuclei of the pollen-grains contain sixteen to eighteen of these bodies: this suggests that their nature may be that of prochromosomes. There is no trace of mechanical tissue in the anther-layers up to the time of degeneration of the periplasmodium. A certain amount of sterile pollen is found in normal pollen-sacs; fertile grains are like those of *G. asclepiadea*. A frequent abnormality is the degeneration of the inner tapetum, usually accompanied by the formation of pollen-grains with normal nuclei and sixteen to eighteen chromatin bodies. More rarely there is entire degeneration of the tapetum, the cells of which show great vacuolization. The pollen-mother-cells in such pollen-sacs are found in all stages of development, or with various meiotic irregularities, and proliferation of the somatic tissues of the anther may occur. J. S.

Chromosome Numbers in Saccharum.—G. Bremer ("De cytologie van het suikerriet. Een cytologisch onderzoek van een vijftigtal in 1929–1930 op Java geïmporteerde rietsoorten," *Archief v. d. Suikerindustrie in Nederlandsch-Indië*, 1934, no. **5**, 141–66). Chromosome numbers were studied in fifty clones of *Saccharum* and some closely related genera imported in Java in 1929 and 1930. Forms with different chromosome numbers occur in the species *S. spontaneum*, the following numbers being found: n = 56, 2n = 112; n = 40, 2n = 80; 2n = 126, 2n = 96 ?, 2n = 72, 2n = 56, and 2n = 62 or 64. The clones with about ninety-six chromosomes probably originated by hybridization between

clones with n = 40 and n = 56. The geographical distribution of these different forms is given. Thirteen clones of *S. officinarum* showed 2n = 80, whilst other numbers occurring in this species are 2n = 60 and 2n = 90. A clone of *S. sinense* showed 2n = 116. The chromosome numbers of certain hybrids were determined: (1) *S. officinarum* × *S. spontaneum* (Talahib n = 40) gives 2n = 120. This number must have been derived from 2 × 40 *officinarum* and forty Talahib chromosomes. (2) *S. officinarum* × *S. spontaneum* (Coimbatore n = 32) gives 2n = 112, also derived by doubling of the *officinarum* chromosomes. (3) British Indian cane var. *Saretha* (n = 46) × *S. spontaneum* (Coimbatore n = 32) gives 2n = 76 and 78. Other somatic numbers found in hybrids are 94, 88, 113, 81, 80 ?, and 70. The last five forms are probably species hybrids of unknown origin. Nineteen haploid chromosomes were found in a form of *Miscanthus japonicus* and forty and sixty somatic chromosomes in forms of *Erianthus arundinaceus* from different localities.
J. S.

Catenation in Œnothera Hybrids.—M. Verbrugge ("Meiosis and Catenation in Certain Crosses of *Œnothera rubricalyx*," *Ann. Bot.*, 1934, **48**, 153–75). The prophase stages are described in detail and figured. Evidence is given supporting the view that several spiremes are present, corresponding in number to the rings apparent at diakinesis. The catenation at diakinesis is studied in several F_1 hybrids of *O. rubricalyx*. The results are tabulated, and the catenation in the male and female parents is given for comparison. A trisomic mutant from *O. rubricalyx* × *O. blandina* shows considerable variations in catenation, the most usual being a chain of nine chromosomes and three pairs. In some cases, in addition to the three pairs, there is a ring of eight chromosomes to which the ninth is attached. This is considered to be the correct configuration in this mutant as all the other variations can be derived from it. One very large pollen-mother-cell of this mutant had thirty chromosomes in ring pairs. This probably originated from chromosome doubling in the last premeiotic mitosis. The relative constancy of the various configurations makes it possible for the catenation to be explained on the hypothesis of segmental interchange, and this is used as a basis for determining the segmental arrangement of the two complexes present in *O. rubricalyx*.
J. S.

Anatomy and Morphology.

Wood Structure of Pseudolarix.—A. S. Peirce ("Anatomy of the Xylem of *Pseudolarix*," *Bot. Gaz.*, 1934, **95**, 667–77, 16 figs.). The vertical elements of the wood are wholly tracheidal with the exception of wood parenchyma, which occupies almost the entire final layer of summer wood. Ray tracheids are not present in the normal wood, nor were any observed in wounded tissues. The end walls of the ray cells are coarse, thick, and profusely pitted with simple pits. Transverse walls are smooth and comparatively thin with sparse simple pits. Radial walls are also smooth and thin with narrowly bordered pits of the *Picea* type, occurring two to four in a cross field in the spring wood and one to two in the summer wood. Transverse walls are straight in the spring wood but converge slightly at the ends in the summer wood, giving the cells a convex shape. End walls occur in a great variety of positions in the spring wood, while in the summer wood they are more consistently vertical. Resin canals are absent. The anatomical characters of the wood indicate that *Pseudolarix* occupies a relatively high position in the Abietineæ. It also shows affinities with the Taxodineæ.
B. J. R.

The Cauline Adventitious Roots of Æschynomene.—W. Russell ("Origine et particularités des racines adventives caulinaires de quelques

Æschynomènes," *Rev. Bot. appl. et d'Agric trop.*, 1934, **108**, 407–11, 3 figs.). The secondary stem structure of *Æschynomene* is peculiar in possessing specialized vascular elements in what have previously been regarded as the medullary rays. The author's examination shows that these structures are, in fact, adventitious root-traces, consisting of a vascular cylinder surrounded by a sheath of parenchyma tissue. In the wood this parenchymatous sheath probably serves the function of transfusion tissue connecting the vascular elements of the root with those of the stem. B. J. R.

Wood Structure of Monotes Kerstingii.—H. BANCROFT ("New Material of *Monotes Kerstingii* from the Gold Coast," *Kew Bull.*, 1934, **6**, 233–7, 1 pl.). The general properties and structure of the wood of *Monotes Kerstingii* Gilg are fully described from representative authentic material collected in comparatively wet savanna forest in the Gold Coast Colony. The wood is hard and heavy, weighing about 66 lb. per cubic foot in the air-dry condition. Growth rings are irregular in contour, marked by zones of denser wood. Vessels are fairly evenly distributed, about twenty-one per sq. mm., mean tangential diameter $61 \pm 15\mu$, mean radial diameter $98 \pm 20\mu$; vessel-segment perforations are simple. Tracheids were not observed. Fibre tracheids, fibres, and forms intermediate between these types of cell form the main ground mass of the wood. Wood parenchyma is fairly abundant in diffuse metatracheal arrangement, sometimes forming short tangential lines. Rays are typically uniseriate, slightly heterogeneous. Secretory canals do not occur. B. J. R.

Ray Tracheids in Coniferous Wood.—S. PLAVŠIĆ ("Ein Beitrag zur Entstehungsgeschichte der Quertracheiden bei den Koniferen," *Arch. f. Wiss. Bot.*, 1934, **22**, 23–7, 3 figs.). Two hypotheses have been proposed for the origin of ray tracheids. Penhallow suggested that they are derived from parenchymatous ray cells, while Thompson's opinion is that they are metamorphosed vertical tracheids. The present paper records observations on *Picea Omorika* which support Thompson's hypothesis. The author suggests that the ray tracheids are actually cut off from the tips of normal vertical tracheids soon after their differentiation from the cambium. B. J. R.

Wood Anatomy of Homoxylous Angiosperms.—K. M. GUPTA ("On the Wood Anatomy and Theoretical Significance of Homoxylous Angiosperms," *J. Ind. Bot. Soc.*, 1934, **13**, 71–101, 7 figs., 6 pls.). The paper comprises a detailed comparative description of the four homoxylous genera, *Tetracentron*, *Trochodendron*, *Drimys*, and *Zygogynum*. Their more important distinguishing features are described and illustrated. The genera fall into two groups, a fact which is correlated with their geographical distribution, *Tetracentron* and *Trochodendron* being found in the Far East, while *Zygogynum* is confined to New Caledonia and *Drimys* has a wide distribution in Australasia and America. The theoretical importance of these genera is briefly discussed in the light of recent discoveries of fossil angiosperms. The age of *Homoxylon* suggests a parallel development of the Magnoliales and the Bennettitales rather than a derivation of the former from the latter.
B. J. R.

Effect of Pruning on Wood Development.—E. M. WRAY ("The Structural Changes in a Woody Twig after Summer Pruning," *Proc. Leeds Phil. and Lit. Soc.*, 1934, **2**, 560–70, 1 pl., 1 fig.). The effect of summer-pruning on the woody growth of the twigs immediately below the wound was studied in two varieties of apple. Reference is made to the standard horticultural practice of making a

pruning cut just above a bud. When this precaution is neglected the basipetal development of the cambium and the dependence of radial growth upon the developing bud results in the isolation of any part of the stem left above the topmost bud as a "snag." Late summer pruning is followed almost immediately by the outgrowth of a single bud. Within a few days of pruning cambial activity begins in the twig below the topmost bud. The first-formed wood is of an abnormal type with no large vessels. Subsequently normal xylem is formed and continues to develop slowly up to the end of October, when the new leaves are expanded. In the unpruned stem growth ceases in July, which coincides with the full expansion of the leaves. It is suggested that the comparatively short basipetal influence of the bud upon growth in a summer-pruned twig is due to shortage of carbohydrates or water supplies or both. B. J. R.

Wound Healing in Submerged Plants.—ESTHER A. RODGER ("Wound Healing in Submerged Plants," *Amer. Mid. Nat.*, 1933, **14**, 704–711). Bog and aquatic representatives of fifteen dicotyledonous and of nine monocotyledonous families were studied. They were found to respond in the following ways: (*a*) By a rotting away of the affected part, accompanied in some cases (as in rootstocks) by a development of a new shoot at the growing point. (*b*) By an obvious thickening of the cell-walls near the wound, this change being unaccompanied by the formation of any meristematic tissue. (*c*) By the formation, from cells which are full grown, of meristematic cells that divide to fill in the air-spaces near the wound with parenchymatous cells. Pseudocicatrice formation does not always precede the formation of periderm, although it may be present and cell-division in the periderm seems only to involve the intra-epidermal layers. Periderm is formed less rapidly in submerged plants than in others, the time of initiation being about equal to the time of completion in land-plants. None of the monocotyledonous plants studied formed periderm as a response to wounding while seventeen out of twenty-six dicotyledonous plants formed at least some periderm. The formation of periderm in one part of a wounded plant does not necessarily mean that it is to be expected as a general reaction throughout the plant. The occurrence of periderm in wounded areas, while not common to all water-plants, is thus not an unusual reaction. A. W. E.

Wound Healing in Kleinia articulata Haw.—N. WOODHEAD ("Studies in Growth and Differentiation. V. Histological and Metabolic Changes during wound-healing in *Kleinia articulata* Haw.," *Ann. Bot.*, 1934, **48**, 467–71, 8 figs.). An account of the histological changes which take place when stems of *Kleinia articulata* Haw. are wounded by cutting them across. Stem wounds on established plants, as well as wounds at both ends of cuttings struck in moist sand, were examined. Observations were also made on wounded leaves and rhizomes. The histological changes in a general way resemble those previously described by other workers in potatoes and sweet potatoes. The exposed cells first become impregnated with fatty materials, and, later on, a phellogen arises within the fatty deposit and produces cork initials and phelloderm. The cork initials do not become extensively suberized. Some of the cells of the phelloderm become collenchymatous, and calcium oxalate crystals are deposited within them. These histological changes are accompanied by changes in the mineral content of the cells below the wounded surface. The most marked changes are that the calcium and phosphate are rapidly removed, whilst there is also a slight depletion of potassium. The phellogen arises in cells from which all or nearly all the calcium has been removed, and the living cork initials cut off from it never contain calcium even in long-healed wounds.

Potassium soon regains its former abundance and distribution, and it is also present in the new cells of the periderm. The author criticizes the physiological mechanism of wound-healing previously described by Priestley and Woffendon (*New Phyt.*, 1922, **21**, 252–68, and *Ann. Appd. Biol.*, 1923, 10, 96–115). C. R. M.

Spontaneous Shedding of the Cuticle on the Petals of Tradescantia.—P. Martens ("Recherches sur la Cuticule—II. Dépouillement cuticulaire spontane sur les pétales de *Tradescantia*," *Bull. Soc. Roy. Bot. Belg.*, 1933, **66**, 58–64, 2 figs.) The petals of *Tradescantia virginica* show two types of spontaneous shedding of the cuticle. The first type, the more precocious, involves the formation of transverse cuticular slits followed eventually by longitudinal rents causing detachment. This takes place above a still living epidermis. The second type, occurring later, consists of large cuticular folds raised up above dead epidermal layers. In the first type of sloughing the tears and subsequent detachment are due to endosmotic elongation of the cells of the lower epidermis, the effect being favoured by the contraction of isolated dead cells and by the transverse elongation of contiguous swollen cells. In the second type the detachment results simply from a considerable shrinking of the dead cells which the cuticle is unable to follow. These phenomena in *Tradescantia* give specially favourable opportunities for making cuticular preparations. A. W. E.

Anatomy of the Seedling of Sorghum.—M. A. Reznik ("Étude anatomique de la plantule de Sorgho," *Rev. Gén. Bot.*, 1934, **46**, 385–416, 14 figs.). The arrangement of the vascular tissue in the region between the root and the stem has not yet been described in the majority of the grasses. Avery considers that there is no transitional region in the hypocotyl of the Gramineæ, the transition taking place entirely in the stem, but the individuals which he examined were already too far advanced. In *Sorghum* seedlings the alternate arrangement in the root and the superposed arrangement in the upper part of the hypocotyl are quite normal. The intermediary phase, intermediate both in time and place, forms the connection between the alternate and superposed systems. Owing to its auxiliary and temporary nature it is susceptible to considerable modifications in different groups of plants. In seedlings of *Sorghum* it corresponds with two successive positions of the xylem: (*a*) external position and (*b*) accessory or auxiliary position. The vascular bundles of the stele of the root are very closely approximated, the intervals between neighbouring bundles being so reduced that the formation of intermediary xylem cannot take place in its normal position. A new vascular tissue thus appears exterior to the phloem. There is a similar formation in the genus *Asparagus*. The xylem of the accessory position forms a little below the level of the first superposed elements. It consists of enlarged cells of the pith with only slightly lignified walls. Some of these cells are elongated horizontally and seem to unite the superposed vessels to the external and centripetal elements. Adventitious roots only develop very tardily in *Sorghum* and do not influence this complex xylem-formation. Thus first the external xylem and then the accessory vessels complete the connection between the xylem of the root and that of the stem. Observations on the structure of that part of the axis which separates the coleoptile from the cushion confirm Celakovsky's opinion that it has a special structure differing from that of the epicotyl. The resemblance is rather with the hypocotyl, though the structure is not identical. The nature of the coleoptile has received various interpretations. Here it is considered to be a dependency of the cushion. For the following reasons it cannot be considered as a distinct leaf: (1) It is inserted on the same side as the cushion; (2) It has no central nerve; (3) Its nerve-traces arise in the stele of

the mesocotyl very close to the cushion; (4) The mesocotyl has not the structure of an internode, but rather of a nodal region of the cushion; (5) The parenchyma of the coleoptile is not differentiated. It only possesses a few stomata and a little chlorophyll along the two nerves; (6) The bilateral symmetry of the coleoptile, with the relationship of its nerves to the single nerve of the cushion, makes it possible to consider this latter nerve as the central nerve of the "ensemble": cushion and coleoptile. A. W. E.

Suppression of the Plumule in Bean Seedlings.—COLETTE GAUTHIER ("Altérations de l'axe hypocotyle de haricots par la suppression de la gemmule," *Ann. Sci. Nat. Bot.*, ser. x, 1934, **16**, 63–92, 15 figs.). The suppression of the plumule in the germinating seed starts a series of disorders in the external morphology, in the vessels, and in the cells. The axis of the hypocotyl becomes more or less long and thick. Shoots frequently appear in the axils of the cotyledons in place of the suppressed axis. The new organs formed render possible the utilization by young tissue of the excess of water transported by the still intact roots. The xylem is developed more or less precociously in various races. The number of xylem-vessels is sometimes augmented, sometimes reduced. The cell-walls are always very little lignified, sometimes even in the oldest vessels. Cellular disorders are shown by an immediate reaction; either by multiplication of the elements, or by their enlargement. The epidermis and endodermis are thus irregularly deformed; the pith is hypertrophied; the phloem diffused among its parenchyma; and the xylem conserves an infantile character. Study of the various disorders, with certain precautions, gives a measure of the vitality of the seeds, varying with their age and race. A. W. E.

Anatomy of Leguminous Leaves.—SHUNJI WATARI ("Anatomical studies on some leguminous leaves with special reference to the vascular system in petioles and rhachises," *J. Fac. Sci. Tokyo Bot.*, **4**, 225–365, 51 figs., 4 pl.). The vascular system of the nodal region, leaf-base, petiole, and rhachis were studied in 133 species of the sub-families *Mimosoideæ, Cæsalpinioideæ,* and *Papilionateæ* of the Leguminosæ. The trilacunar type of node was found in all species of the *Mimosoideæ* studied and in most of the other species. The unilacunar type was found in the *Papilionateæ* in a few closely related genera, while the multilacunar type appeared in the *Cæsalpiniodeæ* and *Papilionateæ* in scattered genera. There are five gaps in most species though seven and nine gaps were noted. Gradual transition between trilacunar and multilacunar types was observed. Stipular traces are always supplied from the lateral foliar trace situated far from the median one. The vascular system in the basal parts of the petiole was divided into three types, viz. Type 1, the case with a single foliar trace. Type 2, the case in which the foliar traces keep more or less apart from one another. This type is prevalent among herbaceous species without a pulvinus at the petiolar base. Seven subtypes are noted. Type 3, the case in which the traces are fused into a continuous arc or ring at the base. This type is usually associated with a pulvinus. Eleven subtypes are recognized. The presence or absence of ridge bundles is very irregular even in one and the same genus. Various modes of behaviour of the ridge bundles are considered. The vascular system above the petiolar top in various leaf-types are respectively discussed. Various external morphological and vascular-anatomical features of each species are summarized in tabular form. F. B.

Anatomy of the Embryonic Leaf.—G. H. SMITH ("Anatomy of the Embryonic Leaf," *Amer. J. Bot.*, 1934, **21**, 194–209, 59 figs.). The author studied the anatomy of embryonic leaves of about eighteen deciduous trees common in

North America. It was found that the leaves of all these trees assume their mature shapes at a very early stage. All embryonic leaves were found to be made up of five to eight tiers of regularly arranged, compact, densely protoplasmic parenchymatous cells of uniform size. This arrangement differed only where provascular areas of smaller, less regularly shaped cells were present. The provascular areas are formed by the horizontal division of one or more contiguous cells of the innermost part of the mesophyll. In the early stages of their development leaves increase in area solely by the formation of new cells. Increase in leaf-area after the bud has swollen in the spring is also due to the growth of the existing cells. Meristematic activity occurs chiefly at the margins of the leaves of some species, but in others cell divisions occur throughout the leaf. Comparisons of " sun " and " shade " leaves showed that a mature " sun-leaf " in all probability is sometimes made up of a greater number of layers of mesophyll cells than were present in the embryonic leaf. In mature " shade " leaves, on the other hand, the author believes the number of layers of mesophyll cells is never in excess of that in the embryonic leaf. C. R. M.

Anatomy of Leaves of Digitalis Thapsi.—T. DEWAR (" The Histology of the Leaves of *Digitalis Thapsi*," *Quart. J. Pharm. and Pharmac.*, 1933, **6**, 443–53, 4 figs.). The leaves of *Digitalis Thapsi* I., which have been offered for sale for medicinal purposes in England, France, and America, are much more " physiologically active " than those of *D. purpurea*. Hence it is desirable that a ready means of distinguishing the powdered leaves of these species should be available. The most important anatomical features of the leaves of *Digitalis Thapsi* are as follows: (1) Glandular trichomes, usually with three- or four-celled stalks, and unicellular heads are present on both surfaces. Trichomes with unicellular stalks and bicellular heads are also present. (2) The cuticle on both surfaces is striated. (3) The stomata are without subsidiary cells. (4) There is usually one water-pore on each tooth of the leaf. (5) Pericyclic fibres are present. (6) Small prisms of calcium oxalate are present in the mesophyll. The presence of the two kinds of glandular trichome, the absence of non-glandular trichomes, the strongly striated cuticle, the presence of pericyclic fibres and prisms of calcium oxalate are all characters which serve to distinguish *D. Thapsi* from *D. purpurea*. C. R. M.

Leaf Anatomy of Atriplex spp.—H. MOSER (" Untersuchungen uber die Blattstruktur von *Atriplex*-Arten und ihre Beziehungen zur Systematik," *Beih. bot. Centralb.*, Abb. B, 1934, **52**, 378–88, 10 figs.). Species of *Atriplex* may be divided into two main groups on the basis of their leaf-anatomy. In one group the leaves have the usual bifacial structure characteristic of most dicotyledons. In the second type the palisade cells are arranged radially around the characteristic parenchymatous sheaths of the vascular bundles. These sheaths consist of large, thick-walled cells which frequently contain chlorophyll. This type of structure is referred to as the " Kranztypus." The author examined the specimens of *Atriplex* spp. in the botanical section of the Natural History Museum at Vienna in order to determine in which species each of these types of leaf-structure occurs. Notes are also given on the occurrence of the " Kranz " type of leaf in other unrelated Dicotyledons, and of leaves having structures intermediate between the " Kranz " and bifacial types. In the genus *Atriplex* a large majority of the species studied (about 100) have the " Kranz " type of structure. The structure of the ovules was also examined. An attempt is made to utilize these anatomical features in classifying the genus. C. R. M.

Resin Canals in the Genus Picea.—S. PLAVŠIĆ ("Über die Harzkanale im Blattkissen der Gattung *Picea*," *Bieh. bot. Centralb.*, Abb. A., 1934, **52**, 290–7, 7 figs.). Wettstein (1890) and F. Mayr (1884) recorded that the resin-canals in the needles of *Picea Ormorica* and *P. excelsa* are directly connected with those in the cortex of the stems or branches to which the needles are attached. Mayr, however, noted that the canals became interrupted in the middle of June at the point of attachment of the needles by a corky tissue. The views of Wettstein and Mayr have hitherto been generally accepted by other more recent workers. The present author's work on the resin-canals in the bases of the needles and the region immediately below shows that there is actually no direct connection between the cortical resin-canals of the stem and those in the needles. The species examined were *Picea Ormorica*, *P. excelsa*, *P. sitchensis*, and *P. ajanensis*. At the base of the needles of *P. Ormorica* a broad sclerenchymatous plate is developed which is penetrated only by the vascular bundle. Below the sclerenchymatous plate there are two to three rows of thick-walled cells which the author believes to be abscission tissue. The resin-canals end blindly above the obstruction offered by these cells. The same was found to be true in the other species studied, but there were minor differences in the structure of each of them. C. R. M.

Anatomy of Pine Needles.—M. SUTHERLAND ("A Microscopical Study of the Structure of the Leaves of the Genus *Pinus*," *Trans. N. Zealand Instit.*, 1934, **63**, 517–68, 44 figs., 2 pls.). In this paper an attempt has been made to draw up a key, based on microscopical characters visible in transverse sections of their needles, by the use of which the various species of *Pinus* that have been introduced into New Zealand may be identified. There are also separate descriptions, each accompanied by a microphotograph, of the species examined. The author found that differences in the following microscopical characters afforded the best basis for identifying species. (1) Shape of the cross-section of the needle. (2) Number and position of the resin ducts. (3) Number and position of stomata. (4) Nature of the hypodermal tissue. Sections were cut mainly in the middle of the needles, but in some instances supplementary sections from nearer the ends were also examined. The author is careful to point out that after further study some of her conclusions may need to be modified. This is on account of the variations in needle structure found to exist within a species. Although other work on the structure of pine needles is referred to, no mention is made of the important paper on this subject by Harlow (*Bull. New York Stat. Coll. Sci. Syracuse*, 1931, **4**, no. 2a). C. R. M.

Cytology and Anatomy of Central European Species of Salvia.—K. HRUBY ("Zytologie und Anatomie der mitteleuropäischen Salbei-Arten," *Beih. Bot. Centralb.*, Abb. A., 1934, **52**, 298–380, 6 pls., 4 figs.). In this paper, information concerning the taxonomy, morphology, anatomy, and cytology of certain species of the complicated genus *Salvia* has been brought together. In the first part of the paper the subject is treated in a general way, but in the second each of the species selected for study is dealt with more fully. Seven species from Central Europe were studied, as well as three species which are characteristically from Southern Europe, but which extend into Central Europe, together with five cultivated species. In the general part, the structure of the seed, its germination, morphology of the cotyledons, structure of the stem, petiole, receptacle, and flower are described, as well as the chromosomes both in the haploid and diploid phases. The paper consists largely of a catalogue of anatomical details which cannot easily be summarized, but can most usefully be referred to in the original text. C. R. M.

Abscission Tissue in Mercurialis annua.—C. YAMPOLSKY ("The Cytology of the Abscission Zone in *Mercurialis annua*," *Bull. Torrey Bot. Club*, 1934, **61**, 279–89, 8 figs.). *Mercurialis annua* bears male, female, and hermaphrodite flowers. The male flowers live only until the pollen has been liberated from the anther-sacs, after which the flowers are thrown off, and a truncated pedicel is left behind. Female and hermaphrodite flowers remain attached to the plant if they are fertilized, but those which are not fertilized differ from male flowers in shrivelling up before they become detached. In the pedicels of all three types of flower the formation of a zone of abscission tissue is initiated at a very early stage. In fertilized female and hermaphrodite flowers the abscission tissue is never completely formed. The author believes that the stimulus of fertilization prevents the continued development of the abscission tissue. The cells of the abscission tissue differ from their neighbours in being filled with homogeneous, non-vacuolated cytoplasm, and in having unusually large prochromosomes in the nuclei. When cell division ceases the cells exhibit an orderly arrangement. Abscission is actually due to the breakdown of the middle lamella between the cells which are about to separate. This process starts at the epidermis and proceeds inwards until the flower is held in position only by the vascular bundle. The vascular bundle is eventually broken mechanically by the weight of the flower. After the flower has fallen "a sticky coagulating fluid" is exuded which "plugs up the opening." C. R. M.

Adventitious Roots in Cotoneaster Dammeri.—FLORENCE WOLFE ("Origin of Adventitious Roots in *Cotoneaster Dammeri*," *Bot. Gaz.*, 1934, **95**, 686–94, 9 figs.). *Cotoneaster Dammeri* Schneid. (*C. humifusa* Duthie) is a prostrate creeping plant readily developing roots in the bud axils. Root primordia originate from only one of the two groups of parenchyma in the divided bud gap. Their formation is apparently due to the resumed activity of the parenchyma cells. A slight protuberance is produced by the cortical cells around the bud axis through which the root emerges. Vascular tissue in the young root arises early, and by the time it is ready to emerge cortex and central cylinder are fully differentiated. As the stem elongates, root-initials develop consecutively. F. B.

Secondary Thickening in the Compositæ.—R. S. ADAMSON ("Anomalous Secondary Thickening in the Compositæ," *Ann. Bot.*, 1934, **48**, 505–14, 7 figs.). An account of the mode of secondary thickening in the stems and roots of some shrubby members of the Compositæ from the south-western Cape region of South Africa. The genera concerned are *Lachnospermum*, *Elytropappus*, *Disparago*, *Stœbe*, *Perotriche*, and *Phœnocoma*. There is no cambium in the primary collateral bundles in the stems of these plants, and secondary thickening is due to the activity of a cambium which arises in the narrow pericycle immediately outside the ring of primary bundles. This cambium produces new tissue almost exclusively on the inside (apart from a small amount of cork formed on the outside). The secondary tissues consist of xylem, phloem, and ground tissue intermixed. The amount and arrangement of each of these tissues varies in different genera, but in every case it is produced in the same way. The cambium layer first formed is persistent, and no successive cambia arise. In the three- or four-arch root of *Metalasea* there is no cambium between the xylem and phloem, but a cambium arises in the pericycle and produces secondary tissues in exactly the same way as in the stem. In fact stems and roots can be distinguished anatomically only when they are young. In *Phœnocoma* the root is four- or five-arch, and in it the cambium arises in the normal position, and produces xylem and phloem in such a way that the xylem eventually has the form of a fluted cylinder with phloem occupying the

grooves. Subsequently a new cambium is formed external to the phloëm strands, where it has the form of a continuous ring and gives rise internally to secondary tissues in the same way as in the stem. In the roots of the other genera examined development occurs as in *Phænocoma* until the fluted cylinder stage is reached, but the nature and arrangement of the secondary tissues produced after that vary somewhat in the individual genera. The author believes that the ancestors of the Compositæ were herbaceous plants and that the anomalous mode of secondary thickening here described has been acquired in correlation with the subsequent development of the shrubby habit. C. R. M.

Transfusion Tissue in the Leaves of the Cycadinæ, Ginkgoinæ, and Coniferæ.—T. van Abbema ("Das Transfusionsgewebe in den Blättern der Cycadinæ, Ginkgoinæ und Coniferæ," *Rec. des trav. bot. Néerlandais*, 1934, **31**, 309–90, 10 figs.). The information in this paper provides a useful summary of the anatomical features of the transfusion tissue in the leaves of certain of the Cycadinæ, Ginkgoinæ, and Coniferæ. Moreover, the various opinions that have been expressed by previous authors concerning the derivation and function of this type of tissue are also summarized. The paper is divided into five chapters. The first is concerned with previous literature on the subject, and the author's technique used during his own investigations. In the second chapter the transfusion tissue of *Cyas revoluta*, *Encephalartos horridus*, and *Ceratozamia mexicana* (as representatives of the Cycadinæ) is described in detail. In Chapter 3 the transfusion tissue of *Ginkgo biloba* is described, and in Chapter 4 that of *Saxegotha conspicua*, *Juniperus drupacea*, *Sequoia sempervirens* var. *adpressa*, *Pinus Pinea*, and *Araucaria imbricata* is dealt with. In Chapter 5 the author summarizes the facts concerning the structure of the transfusion tissue, and sets forth and criticizes the various theories concerning its function and derivation. C. R. M.

Medullary Bundles of Achyranthes aspera L.—A. C. Joshi ("Variations in the Medullary Bundles of *Achyranthes aspera* L., and the Original Home of the Species," *New Phyt.*, 1934, **33**, 53–7, 2 figs.). Transverse sections of internodes of the stem of *Achyranthes aspera* (and of certain other species) show that there are frequently two collateral medullary bundles inside the normal vascular ring. The author examined material of *A. aspera* from Lahore, Bombay, Calcutta, and Benares, and found that these two medullary bundles were not universally present. In plants from Lahore, two medullary bundles were observed in only two or three internodes of the stem immediately below the flowering spikes. In most internodes the medullary bundles fuse together to form a single amphixylic bundle. In plants from Bombay amphixylic bundles were found only in nine pieces of stem from among a collection of forty-nine examined. The few pieces with fused bundles probably came from near the base of the plant. Twenty-five plants from Calcutta were examined, and in only one internode from the base of one plant was a fused medullary bundle observed. About fifty complete plants from Benares were studied. These were collected from every type of habitat in which the plants grow. No variations according to the habitat were observed, but fused amphixylic bundles occurred here and there in about half the plants. The author believes the possession of two free medullary bundles to represent the primitive condition in *A. aspera*. Hence it follows that plants from Calcutta and Bombay, where the medullary bundles are usually free, are more primitive than those from the Punjab, in which fused bundles are dominant. Hence the author concludes that the original home of the species in India was in the south in the tropics, whence it has spread northwards to sub-tropical parts. C. R. M.

Root Structure of Silene vulgaris and S. maritima.—M. E. MILLNER ("Anatomy of *Silene vulgaris* and *Silene maritima* as Related to Ecological and Genetical Problems. I. Root Structure," *New Phyt.*, 1934, **33**, 77–95, 19 figs.). This paper is the first of a series dealing with the anatomy of the vegetative and reproductive parts of *Silene vulgaris* and *S. maritima*, and of their variations and the hybrids between them. The work to be described will involve correlating the anatomical structure with genetical results and a wide range of environmental conditions. In the present paper the specific structural differences between *S. vulgaris* and *S. maritima* are described, as well as anatomical fluctuations due to edaphic factors in the roots of *S. vulgaris*. The primary structure in the roots of both species is diarch, and a large proportion of the root-xylem is made up of storage parenchyma. The vessels near the centre of the roots are irregular in their course, owing to their being bent and twisted amongst the storage parenchyma cells. The food reserves consist chiefly of protein and glucose. *S. maritima* differs from *S. vulgaris* in having more numerous vessels, no medullary rays, and in possessing definite spring and autumn wood. Roots of *S. vulgaris* grown on clay have comparatively little periderm compared with those of plants grown on sand, whilst intermediate stages were found in the roots of plants grown on other experimental soils. Roots from sandy soils have more numerous vessels and narrower medullary rays than those grown on clay soils. C. R. M.

Storage Tracheids in the Styles and Stigmas of certain Ericaceæ.—F. POHL ("Speichertracheiden in der Narbe und im Griffelende einiger Ericaceen," *Ber. Deutsch. Bot. Gesch.*, 1934, **52**, 203–4, 2 figs.). In *Ledum palustre* L. a single vascular bundle is present in the style. The hadrome portion of the bundle is made up usually of two, but in other instances of one or four spirally-thickened tracheids. The vascular bundle branches immediately below the end of the style so as to form a crown of bundle endings. These ends consist of short, wide, spirally-thickened water-storage tracheids. Most of the storage tracheids are directly connected with the vascular bundle of the style, but others of them are connected with elongated tracheids which end blindly in the parenchyma of the style. The walls of the storage tracheids are less strongly lignified than those in the vascular bundles of the style. Very similar storage tracheids were also observed in the ends of the styles of *Erica arborea* L. In this plant some of the storage tracheids at the ends of the hadrome system have the form of pitted cells without spiral thickening. No storage tracheids which were not directly connected with the bundle system of the style were observed in *E. arborea*. Similar storage tracheids are stated to be present in *E. caffra* and *E. hiemalis*. In *E. carnea* L., *Vaccinium Oxycoccus* L., and *V. Vitis-Idæa* no true storage tracheids are present, and the bundles of the styles terminate in short, narrow tracheids which taper to a point at both ends. C. R. M.

Occurrence of Lignin in Orchid Flowers.—L. MÜLLER ("Verholzung in einer Orchideenblute," *Ost. Bot. Zeitsch.*, 1934, **83**, 98–108, 6 figs.). The author carried out an anatomical investigation of the flowers of *Dendrobium Phalaenopsis* Fitzger, and demonstrated the presence of lignified tissues in the rostellum and anther-cap. The rostellum consists of two portions, of which the lower consists of strongly lignified parenchyma cells. The lignified portion extends across and somewhat beyond the funnel-shaped cavity of the stigma. It is covered over by parenchyma, and between the two tissues there is a whitish mass of so-called cement. Microchemical tests made with the cement showed that it contained constituents which gave a positive reaction for sugar and wax respectively. Lignin

was also detected in the walls of the anther-sacs. The characteristic circular and U-shaped thickenings in the fibrous layer were also found to be lignified. The remainder of the anther-cap consists of unlignified parenchyma. *Dendrobium nobile*, *D. crumenatum*, and *D. Pierardii* were also examined, but not more than a mere trace of lignin was detected in the rostellum of these species, although the walls of the anther-sacs were found to be lignified. C. R. M.

Morphology, Anatomy, and Germination of Telfairia pedata Hook.—P. Leuthold ("Beitrage zur Morphologie und Keimungsphysiologie von *Telfairia pedata* Hook," *Beih. bot. Centralb.*, Abb. A., 1934, **52**, 148–204, 18 figs.). In this long paper the systematic position, culture, external morphology, internal anatomy, the chemistry of the seed, and physiological experiments on the germination of the African oil plant *Telfairia pedata* are described. Attention was directed especially to the external morphology and anatomy of the seed. The fibrous covering of the seed arises from the mesocarp, which consists of four to seven layers of cells. These cells form a cambium-like tissue, which, during its development, gives rise to the fibres. Fibres are first formed when the seed is about 5 mm. long. A transverse section through the testa reveals the following structure. The small humps, which are present on the surface of the seed, consist of palisade-like cells which have become divided transversely into smaller cells. The remains of undivided palisade cells are also present between the humps. Beneath the humps is the yellow coloured part of the testa which consists of irregular shaped cells with very thick walls and simple pits. The greater part of the testa is composed of these cells, but towards the inside there are similar but larger and more darkly coloured cells. Passing inward, the next region consists of two to three rows of specially large, regularly arranged cells. Beneath these again there is a single row of small but strongly thickened cells without pits. Below these there are thin-walled cells containing dried up chlorophyll which give a green colour to the inner part of the testa. Dried-up vascular bundles are also present in this region. Beneath the testa there are green and silver coloured coverings to the seed, of which the green one consists of five and the silver one of two layers of cells. The hard testa and outer part of the green covering of the seed arise by the development of the outer integument. The inner part of the green covering is developed from the inner integument, and the outer of the rows of cells of the silver covering from the nucellus. The inner silver coloured layer arises from the embryo-sac. When plants are grown in alkaline soil (pH 7·5) each leaf is provided with thirty-five cystoliths, whereas in leaves of plants grown on acid soil (pH 4·5) there are only sixteen. Similarly in leaves of plants grown on soil rich in calcium there were found to be thirty-four cystoliths, as opposed to fourteen in leaves from soils deficient in calcium. The structure and mode of development of the extra-floral nectaries are described in detail. The cell-walls of the nectaries on leaves not more than 2 mm. long were found to be of cellulose. As the nectaries grow older the cell-walls become suberized. This process begins before secretion. The author believes that the most important function of the nectaries is the regulation of water. The fact that they secrete sugar at the same time is thought to be purely incidental. Experiments on the germination of the seed were also carried out. Notes on the anatomy of the stem and leaf are also given. C. R. M.

Morphology of Austrotaxus spicata Compton.—W. T. Saxton ("Notes on Conifers VIII. The Morphology of *Austrotaxus spicata* Compton," *Ann. Bot.*, 1934, **48**, 411–27, 25 figs.). The ovule of *Austrotaxus spicata* arises terminally on the short primary fertile branch. Its structure at the time of pollination is similar

to that of *Taxus*. Usually only one of the potential spore-mother-cells (which are situated deep in the tissues of the nucellus) develops, but evidence was found that more than one may sometimes divide. The gametophyte is larger than that of *Taxus*, and sometimes more than one gametophyte is present. The relatively large archegonia resemble those of *Cephalotaxus*. The early stages in the development of the embryo resemble those in *Taxus* and *Cephalotaxus*, and the vascular system of the ovule, details of which are given, is in many ways similar to that of *Taxus*. However, the author doubts whether the theory put forward by Sahni (*Ann. Bot.*, 1920, **34**, 117–33) in explanation of the relationship between the vascular systems of the ovules in the different genera of Taxaceæ can be accepted. He believes the male cone of *Cephalotaxus* to be of a more primitive type than that of *Taxus*, and points out that, if the sporangiophore of the Cordaitales may be regarded as near the original type, " by fusion of its sporangia and shortening of the stalk we have the condition in *Austrotaxus*, where not infrequently a single sporangiophore is axillary to the bract." C. R. M.

Development and Mode of Arrangement of the Sepals in Dicotyledons. —M. Breindl (" Zur Kenntnis der Baumechanik des Blutenkelches der Dikotylen," *Bot. Archiv.*, 1934, **36**, 191–268, 75 figs., English summary). This long paper is concerned with the development and arrangement of the parts in the calyces of a wide range of Dicotyledonous plants. C. R. M.

Embryology of Eugenia.—L. van der Pijl (" Ueber die Polyembryonie bei *Eugenia*," *Rec. des trav. bot. Néerlandais*, 1934, **31**, 113–87, 18 figs.). This paper is divided into four main sections. In the first of these the author discusses the various known instances of polyembryony and related phenomena. In the second he is concerned with polyembryony in the genus *Eugenia*, and in the third and longest section he gives an account of his own special investigation of the embryology of *Eugenia Jambos*, *E. malaccensis*, *E. Cumini*, and other species. In the last section the various " explanations " of polyembryony are discussed. In his own investigations the author observed true polyembryony in *Eugenia Jambos* and *E. malaccensis*. Instances of as many as thirteen embryos from a single seed are recorded. The embryology of *E. Cumini* and several other species was generally found to be normal in plants growing in Java, but a number of abnormal seedlings were also observed. The embryo-sac mother-cell of *E. Jambos* gives rise to a five-nucleate embryo-sac. Diakinesis was observed. True apogamy does not occur in this species, but reduction divisions and fertilization are abnormal. In *E. Jambos*, embryonic cells arise near the uni-nucleate embryo-sac, and, after dividing, pass into the embryo-sac and develop into embryos. The embryo which is formed from the egg-nucleus probably degenerates. The adventitious embryos of *E. Jambos* develop autonomously, but degenerate owing to lack of nourishment if fertilization does not take place. Adventitious embryos arise in the tissues of the integument in *E. malaccensis*. Vascular bundles were observed in the integument in all the species of *Eugenia* that were studied. Studies of the chromosomes show that the occurrence of adventitious embryos in *Eugenia* is not due to polyploidy, nor can the abnormal embryology be accounted for on a hormone basis. C. R. M.

Anomalous Embryos of Prunus.—H. B. Tukey (" Anomalous Embryos of Cultivated Varieties of *Prunus* with Particular Reference to Fruit Breeding," *Bot. Gaz.*, 1934, **95**, 493–7, 22 figs.). An account of some abnormal embryos of cultivated varieties of *Prunus Avium* L. and *Prunus persica* Stokes. The abnormal embryos are characterized chiefly by having supernumerary cotyledons, or one cotyledon

partly or wholly suppressed. The number of cotyledons in embryos having an abnormally large number was seldom more than three, although one having four cotyledons was observed. These embryos were found to be capable of germinating, and gave rise to seedlings 6 inches high when grown on suitable culture media. In embryos with reduced cotyledons it sometimes happens that one cotyledon develops more than the other, but in other instances one is completely suppressed. Another variation is that the two cotyledons sometimes grow together so as to have the appearance of a single cotyledon, but when this is so the line of cleavage between the two can always be seen in microscopical preparations. Embryos with unusual shapes were also observed. Anomalous embryos are stated to be more common in cultivated varieties than in wild species. C. R. M.

Sporogenesis and Embryo Formation in Fitzroya patagonica.—J. Doyle and W. T. Saxton ("Contributions to the Life History of *Fitzroya*," *Proc. Roy. Irish Acad.*, 1933, **41**, 191–217, 28 figs., 2 pls.). In *Fitzroya patagonica* Hook. f. pollen-grains are uninucleate when shed and develop normal gametophytes with two equal male cells. Pollen-tube growth is precocious. A linear group of three megaspores is formed from a single functioning megaspore-mother-cell. An apical archegonial complex is the rule, though there is a tendency to lateral development. A ventral canal nucleus is produced, but its subsequent fate is doubtful. The male and female nuclei may be sub-equal when brought together in the archegonium or the male somewhat smaller than the female. The pro-embryo is very variable and the variations seem to be derivatives of two types of early pro-embryo. The mature pro-embryo is fully septate and fills the archegonium. It is concluded that, in general, *Fitzroya* is intermediate between the Cupressinean and Callitrinean forms. F. B.

Pollen Grain and Ovule Development in Potamogeton crispus L.—Babu Lal Gupta ("A Contribution to the Life History of *Potamogeton crispus* L.," *J. Ind. Bot. Soc.*, 1934, **13**, 51–65, 5 figs., 3 pls.). In *Potamogeton crispus* the two-layered anther-wall surrounds a two-layered tapetum which forms a true periplasmodium as in *P. foliosus*. The microspore-mother-cell produces a tetrad of four isobilaterally arranged microspores. Normal trinucleate pollen-grains are formed and the male cells are sickle-shaped. The megaspore-mother-cell gives rise to three or four megaspores. The lowest, functional megaspore gives rise to a normal embryo-sac. The synergids and antipodals are ephemeral and disorganize quickly. The fusion nucleus is the largest nucleus in the embryo-sac. The inner of the two integuments becomes four to six cells thick at the micropylar region. The ovule which at first is almost straight becomes completely inverted at maturity. F. B.

CRYPTOGAMIA.

Pteridophyta.

Isoëtes.—T. Ekambaram and T. N. Venkatanathan ("Studies on *Isoëtes coromandelina* L. I. Sporogenesis, *J. Ind. Bot. Soc.*, 1933, **12**, 191–225, 5 pls. and 10 figs.). This is the only species of *Isoëtes* found in India. Microsporangia are scarce; most plants are megasporangiate. The velum is a rudimentary structure situate between the ligule and sporangium; it is of independent vegetative origin. The tracheids of the velum are connected with the leaf-trace bundle, which suggests that the velum is a fundamental part of the leaf, presumably older than the ligule. The sporangium originates from a superficial group of cells. The spore-mother-cells are scattered, and not confined to any hypodermal layer. In the megasporangium

the spore-mother-cells do not all reach maturity; only a few reach the stage of reduction division and form spores. In the microsporangia groups of cells are marked out to form mother-cells; the sterile tissue becomes transformed into trabeculæ, tapetum, and wall-cells. The different phases of the reduction division are described in detail in the paper. The haploid number of chromosomes for the species is 16. A. G.

Trichomanes radicans.—P. JOVET ("Le *Trichomanes radicans* Sw. et l'*Hymenophyllum tunbridgense* Sm. en pays basque français," *Bull. Soc. Bot. France*, 1933, **80**, 797–809, 2 figs.). A discussion of the confused synonymy of *Trichomanes radicans* and of the allied species referred to that name. The species found in France occurs only in the Basses-Pyrénées. An extremely careful description is given of the few known stations (moist grottoes), the ecology, the associated phanerograms and bryophytes. An analysis of the frond is figured and described. The distribution in France and the ecology of *Hymenophyllum tunbridgense* is also discussed. A. G.

Paraguay Ferns.—J. B. KÜMMERLE ("Die paraguayanischen Pteridophyten-Sammlungen J. Daniel Anisits's," *Magyar Bot. Lapok*, 1933, **32**, 58–63). An obituary notice of Johann Daniel Anisits, for twenty years professor of biology in Asuncion, and a list of the ferns which he collected in Paraguay, some fifty in number. A few new combinations are created. In a critical note on the genus *Salvinia*, *S. hispida* H. B. K. is shown to be distinct from *S. auriculata* Aubl.; and *S. biloba* Raddi is shown to be conspecific with *S. oblongifolia* Mart., and not with *S. auriculata*. Raddi's figures have given rise to confusion. A. G.

Javanese Ferns.—O. POSTHUMUS ("Second Note on Ferns from Java," *Bull. Jard. Bot. Buitenzorg*, 1933, Sér. III, **13**, 91–8). A series of critical notes on some Javanese ferns which were insufficiently known and which the author was able to identify by studying the big herbaria. For instance, *Cystopteris tenuisecta*, originally described by Blume as a species of *Aspidium*, has since been referred to *Alsophila*, *Athyrium*, and *Asplenium*, but in 1920 was identified by Brause with *Cystopteris setosa* Beddome. It is different from the other species of *Cystopteris*, and shows affinity with *Dryopteris scabrosa* O. K., with *Stenolepis tristis* Rosenburgh, and with *Hypolepis alpina* Hook. A. G.

Bryophyta.

Ricciocarpus.—DOROTHY SUTLIFFE ("*Ricciocarpus natans* in California," *Leaflets of Western Botany*, 1934, **1**, 96). Records the presence of *Ricciocarpus natans* in California where it has been noticed in three localities. It has been found also in Oregon and Washington. A. G.

Lejeunea.—FR. VERDOORN ("Revision der von Ozeanien, Australien und Neuseeland angeführten Lejeuneaceæ holostipæ," *Blumea*, 1934, **1**, 216–40). A revision of all the species of Lejeuneaceæ with entire stipules hitherto recorded from Australasia and Oceania. This revision is based upon an examination of type material with few exceptions. About 250 species were studied, and these referred to their proper systematic positions have so become reduced to fifty-nine accepted species. A. G.

American Hepatics.—A. H. BRINKMAN ("List of Hepatics of Pacific Coast and Adjoining Territory," *Report of Provincial Museum Nat. Hist. British Columbia. Victoria*, 1934, 24–33). A list of 254 hepatics with their distribution in Western States and Provinces of the United States and Canada, with critical notes and with

an account of the literature in which further details may be studied as to the hepatics of the districts concerned. British Columbia provides 186 species, Alberta 105, Alaska 109, Washington 130, California 112; from other States there are fewer records, for instance, Wyoming thirty-eight. A. G.

Polytrichaceæ.—STANISLAWA SZYMANSKA ("Structure de l'appareil stomatique chez les Polytrichaceæ," *Act. Soc. Bot. Poloniæ*, 1931, **8**, 141–56, 6 figs.). The stomata of the Polytrichaceæ consist of two long reniform cells, usually with the inner cellulose wall thicker than the outer. The stoma cells in species that grow in moist habitats are longer than in those of dry habitats; but *Psilopilum* is exceptional in having the longer type of cells though growing in a dry habitat; the stomata in *Psilopilum* are sunk below the surface. In the Polytrichaceæ of moist habitats, the calyptra is shorter and does not cover the whole of the theca. The stoma-cells contain chloroplasts and starch-grains. The size of the ostiole depends on the intensity of the light. The cavities beneath stomata vary in shape and size. The number of stomata upon a square millimetre of surface depend largely on the habitat, whether wet or dry, being greater in a damp habitat. A. G.

Ulota.—N. MALTA ("A Survey of the Australasian Species of *Ulota*," *Act. Hort. Bot. Univ. Latviensis*, 1932, **7**, 1–24, 12 figs.). A chapter from a coming monograph of *Ulota* for the whole world. An investigation of the Australasian species has led to the detection of five new species, four of which had been confounded with *U. lutea* the common species of the region. Eight species are now accepted for the region, and these are defined, discussed, and figured. Also a key is provided. A. G.

Italian Mosses.—ENRICO SANTARELLI ("Contribuzione alla Flora Briologica delle Alpi Apuane," *Nuov. Giorn Bot. Ital.*, 1933, **40**, 342–400). An account of the moss flora of the Apuan Alps comprising 773 species, classified according to Brotherus's "Laubmoose Fennoskandias" (1933), with a discussion of the special conditions of the region. The Apuan Alps form an outlying group in the neighbourhood of Lucca and include the famous marble mountain Carrara. A. G.

Portuguese Mosses.—ANTÓNIO LUÍS MACHADO GUIMARÃES ("Sinopse das Briófitas de Portugal. Segunda parte, Musgos," *Bol. Soc. Broteriana*, 1929–1930, **6**, 180–265, 9 figs.). A continuation of a systematic account of the mosses of Portugal described in Portuguese. The present instalment treats of the Grimmiales, Funariales, Schistostegiales, Eubryales (*Bryum, Mnium, Bartramia*, etc.). Keys to the genera and species are provided. A. G.

Portuguese Mosses.—ANTÓNIO LUÍS MACHADO GUIMARÃES ("Sinopse das Briófitas de Portugal. Segunda parte, Musgos," *Bol. Soc. Broteriana*, 1931, **7**, 169–328, 10 figs.). Completion of the synopsis of Portuguese mosses, including the Orthotrichineæ, all the pleurocarpous mosses, the Polytrichineæ, Andreæales, and Sphagnales. A. G.

Hungarian Bryophytes.—ALBERT LATZEL ("Moose aus dem Bakony- und Vértes-gebirge," *Magyar Bot. Lapok*, 1933, **32**, 153–82). A list of twenty hepatics and 163 mosses with numerous varieties collected by Degen and others in the Bakong and Vértes mountains, including fifteen species and several forms which are additions to the Hungarian flora. A new species of *Bryum* is described. The geographical and ecological features of the district are described; and some Mediterranean elements in the bryological flora are indicated. A. G.

Thallophyta.

Algæ.

Oscillarieæ.—P. Gavaudan and N. Gavaudan (" Quelques remarques sur la cytologie des Oscillariées," *Bull. Soc. Bot. France*, 1933, **80**, 706–12, 1 pl.). A preliminary discussion of the cytology of the Oscillarieæ, including the views of authors as to whether the cell contains a primitive nucleus or not. The writers describe the methods and staining reagents which they themselves employed in attempts to solve the problems ; and they give a series of forty-six figures showing the results which they obtained by staining living and dead cells. They believe that there is a central body in the cell with a reticulated vacuolar structure, an organized apparatus of a nuclear nature. A. G.

Algæ of Dauphiné.—P. Frémy and M. Guinochet (" Contribution à la flore algologique des Alpes dauphinoises," *Bull. Soc. Bot. France*, 1933, **80**, 576–81). A list of nearly 100 fresh-water algæ found in fifteen gatherings made in streams, lakes, and pools, on the massifs of Taillefer and Grand Veymont in the alps of Dauphiné. The diatoms are not included. A. G.

Latvian Algæ.—H. Skuja (" Beitrag zur Algenflora Lettlands. I," *Act. Hort. Bot. Univ. Latviensis*, 1932, **7**, 25–86, 115 figs.). An account of 265 forms of fresh-water algæ mostly new to the Latvian flora, comprising 44 Flagellatæ, 1 Silicoflagellata, 12 Dinoflagellatæ, 29 Cyanophyceæ, 61 Chlorophyceæ, 5 Heterokontæ, 113 Conjugatæ. The novelties described for the first time are twenty species and two varieties. A. G.

African Algæ.—Florence Rich (" Scientific Results of the Cambridge Expedition to the East African Lakes, 1930–1, — 7. The Algæ," *J. Linn. Soc. Zool.*, 1933, **38**, 249–75, 4 figs.). The algæ of most of the great African Lakes have been investigated by the Wests and others. The present paper is of interest as including the algal flora of Lake Rudolph in the desert region of Northern Kenya and of the Crater Lakes on its Central Island. The distinctive algological features of each of the lakes visited by the Cambridge Expedition are pointed out ; and a systematic list is provided of all the species observed, 116 in number, as well as several varieties. Some new forms are described and figured ; and critical notes are appended. A. G.

Quebec Algæ.—Jules Brunel (" Études sur la flore algologique du Québec.—I." *Contr. Labor. Bot. Univ. Montréal*, no. 22, 1932, 3–19, 3 figs.). A preliminary list of the freshwater algæ gathered within 50 miles of Montreal, including 14 Myxophyceæ, 52 Chlorophyceæ, 3 Heterokonteæ, and 5 others. Thirty-three of these are additions to the flora of Quebec, and *Schizochlamys delicatula* var. *filamentosa* is described and figured as new to science. A. G.

Fresh-water Plankton.—Samuel Eddy (" A Study of Freshwater Plankton Communities," *Univ. of Illinois Bulletin*, 1934, **31**, no. 45, 1–93, 9 figs.). A discussion of the constitution of the plankton in streams, and in lakes and ponds ; of seasonal communities of plankton organism ; of plankton development and related factors ; of geographical distribution and ecological classification ; with a series of tables. Both animal and plant plankton are included in the study. A. G.

Caulerpa.—M. O. P. Iyengar (" On the Formation of Gametes in a *Caulerpa*," *J. Ind. Bot. Soc.*, 1933, **12**, 325). In recent years swarm-spores in *Caulerpa* have been recorded by two observers. And now a third instance is announced.

Biciliated swarm-spores were observed to be formed in large numbers in *Caulerpa racemosa* var. *uvifera*. These swarm-spores proved to be gametes conjugating freely. The development of the zygotes was not followed. A. G.

Dasya.—T. Rosenberg ("Zur Anatomie und Entwicklungsgeschichte von *Dasya arbuscula*," *Bot. Notiser*, 1933, 535–42, 2 figs.). An account of the anatomy and reproductive apparatus of *Dasya arbuscula*, illustrated by several figures. A. G.

Gymnogongrus.—E. Chemin ("Sur le mode de reproduction de *Gymnogongrus Griffithsiæ* Mart. et de quelques espèces du même genre," *Bull. Soc. Bot. France*, 1933, **80**, 755–70, 2 pls. and 8 figs.). An investigation of the relation of *Actinococcus* to *Gymnogongrus*. It was found that *Actinococcus* has no right to be maintained as a genus, and that its so-called species are but the nemathecia of the algæ on which they occur. The nemathecia result from the development of a female organ, probably after fecundation, as in *Phyllophora Brodiaei* and probably in *Gymnogongrus dilatatus* and *G. platyphyllus*. No cystocarp is formed. Thus a new type of life-cycle in the Florideæ is revealed. After fecundation the egg gives rise to a tetrasporophyte which develops upon the gametophyte and produces spores which germinate and give rise to the gametophyte without any intermediate stage. This new life-cycle fills a gap in the series of types of reproduction in plants. A. G.

Polysiphonia.—R. E. Schuh ("On *Polysiphonia fibrillosa* in New England," *Rhodora*, 1933, **35**, 391–2). *Polysiphonia fibrillosa* is common south of Cape Cod, where it grows to a height of 4–10 inches. Its eastern limit appears to be on the coast of Maine, where its height is but a few millimetres, and its reproductive organs are few or imperfect. Every consideration indicates that this species was not evolved on the North American Coast, but was an immigrant from the west coast of Europe, where it abounds, perhaps during the mild climate of the Cretaceous before the Arctic Ocean became joined to the Atlantic. A. G.

Lithothamnieæ.—Marshall A. Howe ("Eocene Marine Algæ (Lithothamnieæ) from the Sierra Blanca Limestone," *Bull. Geolog. Soc. America*, 1934, **45**, 507–18, 5 pls.). Descriptions of four new fossil coralline algæ from California—*Mesophyllum Schenckii*, *Archæolithothamnium Keenani*, *Lithothamnium laminosum*, *Lithophyllum Sierræ-Blancæ*, with figures of their structure. A. G.

Hawaiian Algæ.—Marshall A. Howe ("Hawaiian Algæ collected by Dr. Paul C. Galtsoff," *J. Washington Acad. Sci.*, 1934, **24**, 32–42, 5 figs.). An account of fourteen marine algæ from Kaneohe Bay, Oahu, and thirteen from Pearl and Hermes Reef. A new species of *Trichoglœa* and two of *Laurencia* are described and figured. A. G.

Fungi.

Cochliobus.—C. Drechsler ("Phytopathological and Taxonomic Aspects of *Ophiobolus*, *Pyrenophora*, *Helminthosporium*, and a new genus, *Cochliobus*," *Phytopath.*, 1934, **24**, 953–84, 3 figs.). Of many *Ophiobolus* species from various sources none gave rise to a *Helminthosporium* stage and none showed any resemblance to species of *Helminthosporium*. Hence the helicoid ascigerous series are regarded as constituting a new genus, to which the name *Cochliobus* is given with *C. heterostrophus*, based on *O. heterostrophus*, taken as type-species. F. L. S.

Ascus abortion.—B. O. Dodge ("A Lethal for Ascus Abortion in *Neurospora*," *Mycologia*, 1934, **26**, 360–77, 3 pls.). This paper describes the genetic effect of treating cultures of *N. tetrasperma* with X-rays. A bisexual culture so treated is practically self-sterile but reacts with tester-strains. The resulting fruits contain some fertile asci and some aborted sporeless asci. The lethal for ascus abortion is segregated at meiosis so that each spore contains at first one normal and one deficient nucleus. Uninucleate and therefore unisexual ascospores after X-ray treatment either die, if they carry the lethal, or are normal and produce normal growth. F. L. S.

Calycina.—F. J. Seaver ("Photographs and Descriptions of Cup-fungi—XXI. The genus *Calycina*," *Mycologia*, 1934, **26**, 344–8, 1 pl.). The author uses this genus, established by S. F. Gray, with *Peziza firma* as type-species and never so far regarded as a valid genus, and includes in it two other species, *C. bolaris* and *C. macrospora* based on *Ciboria bolaris* Fuck. and *Helotium macrosporum* Peck respectively. Excellent illustrations are included of the spores. F. L. S.

Mycological Notes.—F. Petrak ("Mykologische Notizen XII," *Ann. Mycol.*, 1934, **32**, 317–448). In the fifty micromycetes described there are six new genera and thirteen new species. The genera are *Scleroparodia, Neothyridaria, Phragmoporthe, Phylleutypa, Caleutypa, Siropleura.* F. L. S.

Ulster Fungi.—A. E. Muskett, H. Cairns, and E. W. Carrothers ("Further Contributions to the Fungus Flora of Ulster," *Proc. Roy. Irish Acad.*, 1934, **42** B, 41–55). A list of 275 species and 9 varieties of fungi comprising additions to the flora since 1931 when the authors published their previous account. The present list brings the total number of fungi to 1199. One hundred and thirty-three of these species and eight varieties are new Irish records, and two species and one variety are new to Britain. F. L. S.

Portuguese Basidiomycetes.—A. X. P. Coutinho ("Basidimicetas novos para a flora de Portugal," *Bol. Soc. Broteriana*, 1931, **7**, 329–56, 2 pls.). This list of about fifty species includes another record of *Coprinus, gracillimus*, which was first found in the University Botanic gardens of Lisbon and described by the author in 1919. F. L. S.

Michigan Agarics.—A. H. Smith ("New and Unusual Agarics from Michigan," *Ann. Mycol.*, 1934, **32**, 471–85, 12 pls.). Of the twenty-four species described in detail there are two new species of *Cortinarius*, one of *Pholiota*, and one of *Pluteus*. The plates are photographs of fruit-bodies. A few outline drawings of cystidia and spores occur in the text. . F. L. S.

Two-spored Forms of Mycena.—A. H. Smith "(Investigations of Two-spored Forms in the Genus *Mycena*," *Mycologia*, 1934, **26**, 305–32, 5 pls.). Fruit-bodies with two-spored basidia occur in nature among those with four spores and single pilei have been found which bear both forms. The only difference between the two is that the two-spored forms have larger spores. Of twenty-seven variants collected fourteen have been correlated with the typical four-spored forms. The occurrence of a third nuclear division in the basidium is regarded as typical for the genus. This third division is also found in the group of two-spored forms characterized by *Mycena metata*, but two nuclei enter each spore. (In the typical forms four nuclei degenerate.) It has not been determined whether these forms are homo- or hetero-thallic. It is expected that they are homothallic. F. L. S.

Boletus.—W. H. Snell ("Notes on Boletes. III," *Mycologia*, 1934, **26**, 348–60, 1 pl.). Remarks are made on morphological differences of various groups of the genus, e.g. the *Versipellis-scaber*, *Granulatus*, *Edulis*, and other sections. Drawings are given of spores and cystidia. F. L. S.

Penetration of Ustilago.—J. M. Walter ("The Mode of Entrance of *Ustilago Zeæ* into corn," *Phytopath.*, 1934, **24**, 1012–21, 2 figs.). The fungus enters by direct penetration through the epidermis of young cells of the corn. Chlamydospores as well as sporidia may cause infection by sending out germ-tubes. F. L. S.

Myxomycidium.—D. H. Linder ("The Genus *Myxomycidium*," *Mycologia*, 1934, **26**, 332–44, 1 pl.). This rare genus was collected in British Guiana on a decaying log. The specimen is pendulous, watery-gelatinous, and shortly-stalked with an ochraceous tinge and forms the basis of the new species, *M. guianense*. Material found in Tennessee, differing in absence of hypobasidia and having long sterigmata, forms the new species *M. nodosum*. F. L. S.

Primula Root-rot.—B. A. Tiddens ("Über die Wurzelfäule der *Primula obconica*, verursacht durch *Thielaviopsis basicola* Ferraris," *Phytopath. Zeitschr.*, 1934, **7**, 223–31, 4 figs.). Infected plants bear yellow or reddish-green leaves with red veins, the outer leaves of the rosettes often being dead, while the roots are rotten. Chlamydospores of the fungus are found on black patches on the roots. Control of the fungus can be effected by treating infected soil with formalin for ten days. Primulas grown in such soil will then be quite healthy. F. L. S.

Ericaceous Fungi.—S. M. Zeller ("Some New or Noteworthy Fungi on Ericaceous Hosts in the Pacific North-West," *Mycologia*, 1934, **26**, 291–305, 1 pl., 5 text-figs.). Twenty-five fungi are described. Among these are four Ascomycetes, one Basidiomycete, and one of the Fungi Imperfecti. They are either new combinations or new species. The new Basidiomycete is *Exobasidium Burtii* which causes yellow galls on the leaves of *Rhododendron albiflorum* and has three-septate spores. F. L. S.

Galls.—G. Arnaud and J. Barthelet ("Les chancres du Cédrela et du Robinier," *Rev. Path. Vég. et Entom. Agr.*, 1933, **20**, 323–32). *Cedrela sinensis* in the avenues of Paris bears galls which resemble those on pear-trees caused by *Nectria ditissima*, but are brought about by the new species, *Fusicoccum Cedrelæ*. The galls on *Robinia Pseudo-acacia* are due to *Diaporthe oncostoma* (*Phomopsis oncostoma*). F. L. S.

Pea-spot.—W. C. Snyder ("A Leaf, Stem, and Pod Spot of Pea caused by a Species of *Cladosporium*," *Phytopath.*, 1934, **24**, 890–906, 3 text-figs.) The disease is most common on peas along the coast of California and is caused by a newly-described species of *Cladosporium*, *C. pisicolum*. Infection experiments showed that all varieties of *Pisum sativum* are susceptible. F. L. S.

Blue-stain Fungi.—R. M. Nelson ("Effect of Blue-stain Fungi on Southern Pines attacked by Bark Beetles," *Phytopath. Zeitschr.*, 1934, **7**, 327–55, 6 figs.). Blue-stain fungi were invariably present in pines attacked by bark beetles. The fungi, *Ceratostomella Pini* and *C. ips*, form black patches on the surface of the wood; medullary rays and sap-wood are also attacked and become blue. Cultural characters of the fungi and inoculation experiments are described. Moisture determinations show that healthy trees have a higher water-content near the

top than at the base—this is the reverse for infected trees. It is concluded that water cannot be drawn through the stained infected part, and that the fungus, by thus reducing the water supply to a degree necessary for beetle brood development, is indispensable to the pine beetle. F. L. S.

Dry-rot.—A. POUCHET ("Considérations générales sur les champignons de charpentes," *Bull. Soc. des Natural. et Archéol. de l'Ain*, 1934, **48**, 67–74, 1 fig.) An account of the method of attack, and development of *Merulius lacrymans* together with preventive and curative measures. F. L. S.

Urocystis.—E. C. STAKMAN, R. C. CASSEL, and M. B. MOORE ("The Cytology of *Urocystis occulta*," *Phytopath.*, 1934, **24**, 874–90, 3 pls.). The spores in germination produce a promycelium on which are formed from two to six sporidia that apparently always remain attached to it. There is a single nucleus in the young promycelium, but this divides to form several. Normally one nucleus passes to each sporidium. Sporidia on the same or different promycelia then fuse and produce binucleate hyphæ. Occasionally two or more nuclei pass directly from the promycelium into a sporidium and the binucleate phase begins without sporidial fusions. The host plant is apparently infected at this stage. When spore-formation begins the nuclei of some of the cells fuse and form mother-cells around which hyphal branches grow, lose their contents, and form the sterile cells around the mother-cell. F. L. S.

Sex in Trametes.—R. VANDENDRIES ("Contribution à l'étude de la sexualité dans le genre *Trametes* (i)," *Bull. Soc. Myc. de France*, 1934, **50**, 98–111, 2 pls.). Vandendries has continued his previous work on the sexuality of *Trametes* by an investigation of two further species, *T. cinnabarina* (Jacq) Fr. and *T. hispida* Bagl. In *T. cinnabarina* the haploid phase is characterized by the production of uninucleate oidia, capable of germinating and of reproducing other haploid strains of the same sex. The diploid phase bears diploid oidia, which are binucleate and cylindrical, and binucleate chlamydospores that are solitary and borne at the end of branches of oidiophores. Both oidia and chlamydospores germinate and produce new diploid mycelium. In *T. hispida* the haploid mycelium resembles that of *T. cinnabarina*, but no oidia have been observed. The results of pairing a number of haplonts show clearly that they fall into four sexual groups, i.e. the species is tetrapolar. F. L. S.

Mycological Species.—L. IMLER ("L'éspece en Mycologie," *Bull. Soc. Myc. de France*, 1934, **50**, 30–7). The author has made another attack on the species problem. He begins by quarrelling with the author of a systematic monograph on the limits of species and varieties and traces the chequered career of one species through a number of studies to declaim pathetically, "Where is the truth now?" In effect he advances the position by contrasting conflicting ideas and points out that normal species standards lack precision in their application to fungi because of the incomplete differentiation of sex that prevails. He concludes a lively assault by reminding us that we have descriptive methods, the microscope, toxicology, smell, and reproduction and writes, "Truly, mycology is more alive than ever." F. L. S.

Lichens.

Lichen Isidia.—R. DUGHI ("La formation et le rôle des papilles scortéales chez les lichens," *Compt. Rend. Acad. Sci.*, 1933, **197**, 695). Dughi has made a study of the isidia of *Parmelia scortea*, a not uncommon lichen, specially distin-

guished by the dark isidia; these are borne chiefly towards the borders of the thallus as minute warts which soon become brown at the quickly enlarging top, remaining narrow at the base. It was found that the upper cortex of these bodies took on the characters of the lower thallus cortex, and even developed rhizines. The arrangement of the tissues resembles that of a young thallus turned upside down, and when fully grown and scattered they initiate new growths. *Parmelia scortea* rarely bears apothecia and therefore depends on these growths for propagation. A. L. S.

Lichen Gonidia.—FREDR. ELFVING ("Zur Gonidienfrage," *Ber. Deutsch. Bot. Ges.*, 1934, **52**, 208–13, 6 text-figs.) In this paper Elfving gives his explanation of the origin and occurrence of the green algal cells in the lichen thallus and records observations of growth in "*Stictina scrobiculata.*" By cutting and examining sections of the thallus at different stages of growth he claims to have confirmed his previous theories as to the origin of the *Nostoc* algal cells. In sections of the young stages of the thallus, at the thin outward edge, he finds strands of colourless cells, further back in the thallus are developed green *Nostoc*-like strands which he maintains are a direct older development from the colourless hyphæ: a slight coloration at first, finally distinct *Nostoc* gonidia and gonidial groups. From further observation he found that the change takes place in early spring, and there follows increase of colourless as well as of green cells. Many things are unexplained by Elfving: as, for instance, the relation between the fungoid fruit formation and the algal thallus, and the great variety of green or blue-green cells that occur even within closely related genera and species of lichens. A. L. S.

Cladoniæ and Umbilicariæ in Italy.—MARIA CENGIA-SAMBO ("Cladonie E Umbilicarie Italiane," *Nuovo Giorn. Bot. Ital.*, 1934, **41**, 142–56). An account of the genera *Cladonia* and *Umbilicaria* from several widely separated districts, though largely in the northern Alpine areas, and also of several lichenologists who have collected. There are recorded eighty-six species and varieties of *Cladonia* and nineteen *Umbilicariæ*. It is interesting to note that no specimen of *Cladonia mitis* is recorded in this paper, while in the Cima d'Asta lists that rather doubtful species is reported once from Lago Grande. A. L. S.

Lichens of Mozambique.—EDV. A. VAINIO ("Lichenes Mozambici," *Bol. Soc. Broteriana*," 1929–30, **6**, 144–79). This paper on lichens was prepared by the author before his lamented death. The plants were collected by Prof. Dr. Americo Pirez de Limo in the northern region of Portuguese East Africa, a district subject to the monsoons with dry and wet seasons. With few exceptions the lichens are crustaceous, the larger forms being represented by one *Parmelia*, one *Ramalina*, and one *Theloschistes*. The Graphidineæ are the most numerous; the very large majority are new species here described for the first time. A. L. S.

Indian Lichens.—GOVARDHAM LAL CHOPRA, with Foreword by HARAPRASAD CHAUDHURI ("Lichens of the Himalayas. Part I," University of the Punjab, Lahore, 1934, **1–6**, 1–105, 12 pls.). This descriptive list of lichens provides a preliminary hand-book to the lichens of Darjeeling and the Sikkim Himalayas. There are a number of new species and one new genus *Chaudhuria* A. Zahlbr. near to Stictaceæ. There are also several new species and varieties. All the plants are fully and carefully described and the descriptions are enriched by the finely drawn plates. A general account of lichens and their classification is given in the preface. The species described number ninety-eight, and the book is further enhanced by a glossary of terms and by lists of genera, etc. A. L. S.

Lichen Studies of Trentino Orientale.—MARIA CENGIA-SAMBO ("Osservazioni lichenologiche sul Gruppo di Cima d'Asta," *Archiv. Bot.*, 1934, **10**, Fasc. 2, 153–73). The writer gives a graphic account of the lichens collected by her on or near the Cima d'Asta, a district of vast extent not previously explored by lichenologists. The plants were abundant and the varied associations were carefully noted and correlated with the climatic, edaphic, and geographic conditions. The Cima d'Asta rises behind the mountains of the Eastern Trentino, and the territory examined included several rivers and stream courses. The group of hills consists mainly of intrusive granite, the characters of which are described in detail; calcareous rocks and soil also occur and are also included in the survey. Rivers and streams are numerous, and glacial action was constantly noted. Ecological conditions and the various associations are recorded. On the higher slopes Lecideaceæ were abundant, but only one representative of Lecanoraceæ, *Lecanora badia*, was collected. Soil lichens were also rather scarce: *Solorina crocea* was one of the most frequent forms. For all the different districts with their soils and aspects an account of the lichens is given with notes on the scarcity or abundance of the species. Finally, lists are provided, as also a comprehensive, classified list of all the lichens collected. A. L. S.

TECHNICAL MICROSCOPY.

Über ein Mikroskopzusatzsystem mit Aperturblende. (A Microscope Accessory System with Iris Diaphragm).—Paul Ramsthaler (Reichert-Werke, Wien), *Zeits. wiss. Mik.*, **51**, 184–7, 1934. With incident illumination it is sometimes desirable to reduce the effective aperture of the objective in order to increase the focal depth. The writer accomplishes this by introducing a well-corrected accessory optical system fitted with an iris diaphragm (Fig. 1). The

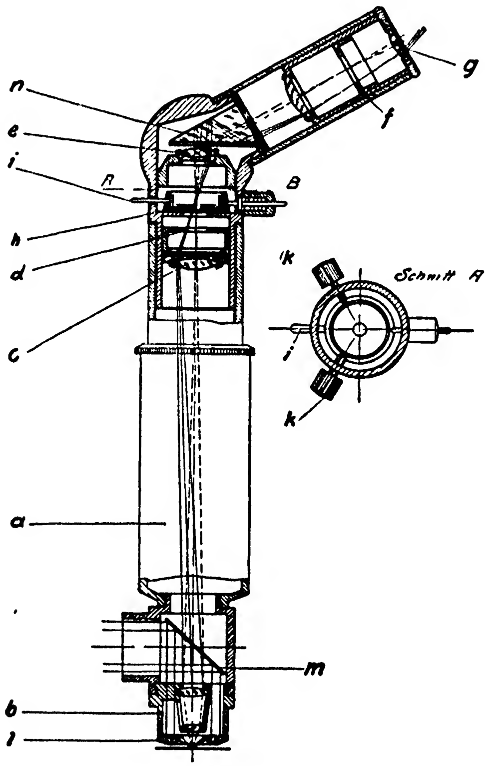

Fig. 1.

accessory system, which is inserted in the place of the eyepiece, forms an image of the exit pupil of the objective in the plane of the iris diaphragm. The diaphragm can be centred in the ordinary way by means of screws and spring. An ordinary eyepiece is inserted above the accessory system. The apparatus is supplied by Reichert under the name of " Inclined ocular attachment with iris diaphragm." In this the eyepiece is set obliquely, a reflecting prism fitted above the accessory system producing the necessary deviation of the issuing rays. A. S. B.

Über ein neues Auflichtimmersionsobjektiv. (A New Immersion Objective for Incident Light.)—PAUL RAMSTHALER (Reichert-Werke, Wien), *Zeits. wiss. Mik.*, **51**, 179–83, 1934. When incident illumination is obtained by combining a ring condenser with an immersion objective, usually the design is such that the condenser is not in immersion contact. This arrangement simplifies construction, but illumination is impaired by the irregular scattering of the incident rays at the surface of the immersion fluid. The objectives of Chapman and Alldridge did not suffer from this defect, but on account of difficulty of construction their price was so high that they did not come into general use. The writer has designed an objective in which the defect is avoided. A plane parallel plate is mounted in front of the objective, which has a N.A. of 0·95. The margin of the plate has a spherical surface and the illuminating rays enter this surface at right angles. They emerge from the lower plane surface, which is in immersion contact, and therefore the plate does not disturb the corrections of the illuminating system. The ring condenser is of the Stephenson reflecting type with a figured (Schmiegungskurve) reflecting surface and is free from chromatic and practically from spherical aberration (Fig. 2). Its mount is not adjustable, but focusing can

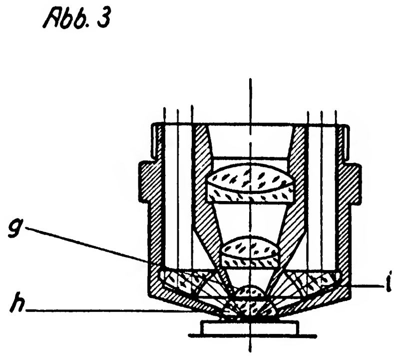

FIG. 2.

be effected by the use of an accessory illuminating system with adjustable optical elements. The objectives are supplied by Reichert. At present oil immersions with a primary magnification of 60 and 100 and a water immersion with a primary magnification of 60 are available. They are in short mounts so that they can be used with the opaque illuminator. They are completely sealed on the object side so that the water immersion can be used as a tank objective. A. S. B.

Kennzeichnung des Vergrosserungsgrades bei Mikrophotogrammen. (Indication of Magnification on Photomicrographs.)—S. ROSCH (Wetzlar, (*Zeit. wiss. Mik.*, **50**, 273–84, 1934). The magnification of a photomicrograph may be given in figures in the margin or indicated by a scale printed on the photograph. The author recommends the latter method because if the photograph is altered in size for publication or in lantern projection the scale shares in the alteration and indicates correctly. He describes various methods for including the scale in the photograph.

Ocular Micrometer.—An ocular micrometer may be included in the photograph. The method is convenient, but the position of the scale is fixed near the centre of the photograph where it may obscure important detail. Moreover, the scale does not give the magnification directly, but its value has to be given in the margin.

Condenser Micrometer.—If no eyepiece is used the previous method is inapplicable. In this case the substage condenser may be used to project the image of a scale into the plane of the object.

Drawing Mirror Process.—The image of a scale may be projected on to the plate by means of a drawing apparatus. The scale must be a "negative" one, i.e. bright lines on dark ground. In a modification of this process a special apparatus is used, which resembles an opaque illuminator, except that the mirror reflects upwards instead of downwards. The scale, together with a small lamp and lens system, is carried in a lateral tube.

Object Micrometer.—The object, after being photographed, is replaced by a negative object micrometer and a second exposure made on the same plate. Incident or dark field illumination, if used for the object, must be replaced by bright field illumination for photographing the micrometer.

Printing-in Process.—An ordinary (positive) object micrometer may be photographed on a separate plate and the two negatives combined in the print. The process is simplified if the worker confines himself to certain definite magnifications, for then the appropriate scales can be kept at hand, obviating the need for photographing the micrometer on each occasion.

The article is illustrated by ten photomicrographs in which scales have been included. These show clearly the value of the author's methods. The necessary scales are supplied by the firm of Leitz. A. S. B.

NOTICES OF NEW BOOKS.

Experimental Bacteriology in its applications to Diagnosis, Epidemiology, and Immunology of Infectious Diseases.—By W. Kolle and H. Hetsch. English version, incorporating further revision, edited by John Eyre. Vol. 1, 592 pp., 118 plates, 200 text-figs. Vol. 2, 613 pp., 118 plates, 200 text-figs. Published by George Allen & Unwin, Museum St., London, W.C. Price 30*s.* per volume net.

Researches on Fungi.—By A. H. Reginald Buller. Vol. VI. 1934. The biology and taxonomy of Pilobolus, the production and liberation of spores in the Discomycetes, and Pseudorhizæ and Gemmifers as organs of certain Hymenomycetes. xii + 513 pp., 231 illustrations. Published by Longmans, Green & Co., 39, Paternoster Row, London, E.C.4. Price 28*s.* net.

The Anatomy of the Salamander. By Eric T. B. Francis, with an Historical Introduction by F. J. Cole. 1934. xxxi + 381 pp., 26 plates. Published by Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 25*s.* net.

An Index to the Genera and Species of the Diatomaceæ and their Synonyms. 1816–1932.—Compiled by F. W. Mills. Part XVI. September, 1934. Na–Ni. 79 pp. Part XVII. October, 1934. Ni–Pl. 80 pp. Part XVIII. November, 1934. Pl–Rh. 80 pp. Published by Wheldon & Wesley, 2, 3, and 4, Arthur Street, London, W.C.2. Price 10*s.* per part.

The Carbohydrates.—By E. F. and K. F. Armstrong. 5th edition. 1934. vi + 252 pp. Published by Longmans, Green & Co., 39, Paternoster Row, London, E.C.4. Price 15*s.* net.

Faune de France. 28. Dipteres (Brachyceres). (Muscidæ Acalypteræ et Scataphagidæ).—By E. Seguy. 1934. 832 pp., 27 plates, 903 figs. Published by Paul Lechevalier et Fils, 12, Rue de Tournon (vi), Paris. Price 300 fr.

The Identification of Firearms and Forensic Ballistics.—By Major Gerald Burrard, D.S.O. 1934. 220 pp., 4 figs., 40 plates. Published by Herbert Jenkins, Ltd., 3, York Street, St. James's, London, S.W. Price 12*s.* 6*d.* net.

The Generic Names of the Holaric Butterflies.—By Francis Hemming. Vol. I. 1758–1863. 1934. vi + 184 pp. Published by the British Museum (Natural History), S. Kensington, London, S.W. Price 7*s.* 6*d.* net.

A Monograph of the Frogs of the Family Microhylidæ.—By H. W. Parker. 1934. viii + 208 pp., 67 text-figs., 2 maps. Published by the British Museum (Natural History), S. Kensington, London, S.W. Price 15*s.* net.

A Systematic Monograph of the Flatfishes (Heterosomata).—By J. R. Norman. Vol. I. Psettodidæ, Bothidæ, Pleuronectidæ. 1934. viii + 459 pp., 317 text-figs. Published by the British Museum (Natural History), S. Kensington, London, S.W. Price 30*s*. net.

The Elements of Experimental Embryology.—J. S. Huxley and G. R. de Beer. xii + 514 pp., with 221 figures. Published by the Cambridge University Press, Fetter Lane, London, E.C.4. 1934. Price 25*s*.

The developmental processes of animals cover such an enormous field of study that it is manifestly impossible to deal with them all in the limits of a single volume. The authors have therefore deliberately restricted themselves to the early period of development, from the undifferentiated condition up to the stage at which the main organs are laid down and their tissues histologically differentiated, in fact, to Wilhelm Roux's "prefunctional period." Special attention is paid to the question of "organizers" in development since the extension of Spemann's concept from the process of grastulation in Amphibia to other stages of development and to other groups of organisms has made it possible to understand on the biological level many processes of development which before were obscure. An interesting section deals with the evidence of tissue cultures on the processes of dedifferentiation and redifferentiation. A full bibliography serves also as an author index. G. M. F.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, OCTOBER 17TH, 1934, AT 5.30 P.M., PROF. W. A. F. BALFOUR-BROWNE, M.A., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

J. C. Simpson, B.Sc., LL.D.	Montreal.
H. E. Rawlinson, M.Sc., M.D.	Montreal.
William Pollock.	Dublin.
Alfred S. Edwards.	Godalming.
Clement C. Croft.	London.
Alfred E. Harwich.	Jerusalem.
Hubert Kufferath.	Brussels.
John H. Matthews, M.R.C.S., L.R.C.P.	Oswestry.
Edward C. Hood.	Chicago.
Leonard H. Cross.	Northwich.

Deaths.—The President announced the regrettable loss to the Society by death of the following Fellows :—

Charles Robert Becke.	Elected 1928.
Joseph Wilson.	„ 1908.

Votes of condolence with the relatives were passed.

Donations were reported from :—

Mr. F. W. Mills, F.L.S., F.R.M.S.—

"An Index to the Genera and Species of the Diatomaceæ and their Synonyms." Parts XIII to XVII. By F. W. Mills.

"An Introduction to the Study of the Diatomaceæ, 1893." By F. W. Mills.

"An Early History of the Diatomaceæ." By F. W. Mills. (Typescript.)

Mr. G. T. Harris,—

"The Œdogoneales of Devonshire." By G. T. Harris.

Prof. Ernst Küster,—

"Hundert Jahre Tradescantia." By Ernst Küster.

"Über Zonenbildung in Kolloidalen Medien." By Ernst Küster.

Messrs. Longmans, Green & Co., Ltd.—

"Research on Fungi." By A. H. Reginald Buller. Vol. VI, 1934.

"Transactions of the Bose Research Institute, Calcutta." By Sir J. C. Bose. Vol. VIII, 1932–3.

Messrs. George Allen & Unwin, Ltd.—

"Experimental Bacteriology." By W. Kolle, H. Hetsch, and John Eyre. Vol. I, 1934.

M. Masson et Cie.—

"Précis de Microscopie." By M. Langeron. 5th edition. 1934.

Oxford University Press,—

"The Anatomy of the Salamander." By Eric T. B. Francis. 1934.

Mr. L. R. Cleveland,—

"The Wood Feeding Roach Cryptocercus, its Protozoa, and the Symbiosis between Protozoa and Roach." By L. R. Cleveland.

Dr J. N. McArthur,—

A Microscope Objective. By Andrew Ross. 1851.

Mr. A. E. Harris, F.R.M.S.—

A Monocular Microscope and Accessories. By Baker.

A Collection of 186 Slides and Photographs of Saprolegniæ, together with notes thereon.

Mr. S. C. Akehurst, F.R.M.S.—

The original Akehurst compressorium with accessory slides in case.

The original Akehurst substage condenser changer.

A Wenham reflex substage illuminator.

Mr. John A. Long, F.R.M.S.—

47 Species slides of Diatoms.

The Royal Society.—

Seventy-five pounds. (£75.)

Prof. T. Koshy,—

Five pounds. (£5.)

Votes of thanks were accorded to the donors.

Papers.—The following communications were read and discussed :—

Dr. Edwin E. Jelley, Ph.D., A.I.C., F.R.M.S.—

"A Microrefractometer and its use in Chemical Microscopy."

Drs. G. M. Findlay, *O.B.E.*, M.D., D.Sc., F.R.M.S., and R. D. Mackenzie, M.B., Ch.B.—

"A New Disease in Mice."

Votes of thanks were accorded to the authors of the foregoing communications.

The following Paper was read in title :—

W. A. Macfadyen and E. J. André Kenny,—

"On the Correct Writing in Form and Gender, of the Names of the Foraminifera."

Announcement.—The Secretary made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, November 7th, 1934.

The Proceedings then terminated.

AN ORDINARY MEETING

of the Society was held in the Hastings Hall, British Medical Association House, Tavistock Square, London, W.C.1, on Wednesday, November 21st, 1934, at 5.30 p.m., Mr. C. Beck, *C.B.E.*, Vice-President, in the Chair.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

J. C. Simpson, B.Sc., LL.D.	Montreal.
H. E. Rawlinson, M.Sc., M.D.	Montreal.
William Pollock.	Dublin.
Alfred S. Edwards.	Godalming.
Clement C. Croft.	London.
Alfred E. Harwich.	Jerusalem.
Hubert Kufferath.	Brussels.
John H. Matthews, M.R.C.S., L.R.C.P.	Oswestry.
Edward C. Hood.	Chicago.
Leonard H. Cross.	Northwich.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

Thomas Allen Roberts.	Guildford.
Ruby Olive Stern, M.D.	Northampton.
Edmund J. Weston.	London.

Deaths.—The President announced the regrettable loss to the Society by death of the following Fellows :—

David L. Bryce.	Elected 1925.
Sydney Klein.	,, 1897.
S. Ramón y Cajal (Hon. Fellow).	,, 1904.
Ganson Depew.	,, 1921.

Votes of condolence with the relatives were passed.

Donations were reported from :—

Mr. F. Martin Duncan, F.Z.S., F.R.M.S.—

The Dallinger Collection of Lantern Slides.

Mr. F. W. Mills, F.L.S., F.R.M.S.—

"An Index to the Genera and Species of the Diatomaceæ." Part XVIII. By F. W. Mills

Messrs. Longmans, Green & Co.—

"The Carbohydrates." 5th edition. By E. F. Armstrong and K. F. Armstrong.

M. Paul Lechevalier et Fils,—

"Faune de France." (28) Dipteres (Brachyceres). By E. Seguy.

Prof. T. K. Koshy,—

Ten pounds. (£10.)

Votes of thanks were accorded to the donors.

Exhibit.—Mr. J. E. Barnard, F.R.S., F.R.M.S., and Mr. F. V. Welch, F.R.M.S., exhibited and described an Intermittent Ultra-Filter Apparatus for Virus Investigations.

Paper.—The following communication was read and discussed :—

Mr. John Smiles, A.R.C.S., F.R.M.S.—

"On the Penetration of a Microscope Objective."

Votes of thanks were accorded to the author of the foregoing communication and to Mr. Barnard and Mr. Welch for their exhibit and demonstration.

The following papers were read in title :—

M. K. Subramaniam, B.A., F.R.M.S.—

" Oogenesis of *Clibanarius olivaceus* (Henderson) with special reference to a seasonal variation in the cytoplasmic inclusions."

Frank J. Myers, F.R.M.S.—

" A New Species of Rotatoria (*Ptygura Libera*)."

Isabel Haughton, B.A., M.Sc.—

" Amœbocytes and Allied Cells in Invertebrata."

Announcements.—The Secretary made the following announcements :—

A letter had been received from Sir William Bragg, O.M., F.R.S. (Royal Institution) appealing for a few old microscopes no longer needed by Fellows and suitable for instructional use in clubs and camps of unemployed men.

Fellows possessing such instruments and willing to present them for this worthy purpose are invited to communicate with the Secretary, Royal Microscopical Society, B.M.A. House, Tavistock Square, London, W.C.1.

The Biological Section will meet in the Pillar Room on Wednesday, December 5th, 1934.

The Proceedings then terminated.

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INDEX OF AUTHORS.

ROYAL MICROSCOPICAL SOCIETY

LIST OF FELLOWS

B.M.A. HOUSE, TAVISTOCK SQUARE, LONDON, W.C 1

September, 1934

THE ROYAL MICROSCOPICAL SOCIETY

Patron.

HIS MOST EXCELLENT MAJESTY THE KING.

COUNCIL

ELECTED 17TH JANUARY, 1934.

President.

W. A. F. BALFOUR-BROWNE, M.A., F.R.S.E., F.Z.S., F.R E.S.

Vice-Presidents.

JOSEPH E. BARNARD, F.R.S., F.Inst P.
CONRAD BECK, *C.B E.*
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G. M. FINDLAY, *O.B.E.*, M.D., D.Sc.

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A. S. BURGESS, M.A., M.D., B.Ch.
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G. S. SANSOM, D.Sc.
D. J. SCOURFIELD, *I.S.O.*, F.L.S., F.Z.S.

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CLARENCE TIERNEY, D.Sc., F.L.S.

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W. E. WATSON BAKER, A.Inst.P.

Joint Hon. Curators of Slides.

N. I. HENDEY, M.P.S.
E. J. SHEPPARD.

Secretary.

CLARENCE TIERNEY, D.Sc., F.L.S.

Any Omissions or Errors in this List should be notified to the Secretary.

LIST OF FELLOWS

OF THE

Royal Microscopical Society

(Corrected to September, 1934.)

ORDINARY FELLOWS.

* *Fellows who have compounded for their Annual Subscriptions.*

Elected		Service on Council, etc.
1920	Adams, Frederick, M.Inst.C.E. *Beauvoir, St. Saviour's, Jersey, C.I.*	
1926	Addey, Frederick, B.Sc., M.I.E.E., F.R.A.S. 29, *The Avenue, Grove-park, S.E.* 12.	
1906	Aitken, Henry James. 23, *Carey Mansions, Vincent-square, Westminster, S.W.* 1.	
1931	Ajinkya, Dheenath Sitanath. *Gordhandas S. Medical College, Bombay, India.*	
1914	Akehurst, Sydney Charles. 51, *King's-avenue, Muswell Hill, N.* 10.	1921-23, 1925 1928; Libr. 1927-1928
1905	*Allis, Edward Phelps, jun., C.E., LL.D., F.L.S., F.Z.S. *Palais Carnolès, Menton, Alpes Maritimes, France.*	
1926	Armitage, Rev. John James Richard. *Christ Church Vicarage, Everton, Liverpool.*	
1924	Armstrong, Robert William, F.S.M.C., F.I.O. 34, *Wilfield-road, Ballsbridge, Dublin, Ireland.*	
1929	Ashby, Thomas Charles. *Woodsdale, Commercial-road, Paddock Wood, Kent, and Government Laboratory, London, W.C.* 2.	
1922	Atwell, Stanley Ernest, F.B.O.A. 57, *Wentworth-avenue, Church End, Finchley, N.* 3.	
1913	Aubin, Percy Adrian. *Mont au Roux, St. Brelade's, Jersey.*	
1912	Audas, James W., F.L.S. *National Herbarium, The Domain, South Yarra, Melbourne, Victoria.*	
1934	Aumonier, Frederic John. 21, *Ashburnham-avenue, Harrow, Middlesex.*	

Elected.		Service on Council, etc.
1932	Austin, Reginald George, B.Sc., A.I.C. *Chemistry Department, Municipal College, Portsmouth, Hants.*	
1923	Baber, Frederick William. 6, *Green-walk, Wood-road, Whalley Range, Manchester.*	
1933	Bailey, Roland Henry. 20, *Groveland-road, Beckenham, Kent.*	
1908	Baird, Thomas Stewart, F.I.O., F.S.M.C., D.B.O.A. 395, *Argyle-street, Glasgow.*	
1915	Baker, Arthur. " *Yews,*" *New Barn, Longfield, Kent.*	
1885	Baker, Frederick Henry, F.L.S. 167, *Hoddle-street, Richmond, Victoria, Australia.*	
1894	Baker, Frederick William Watson, F.Inst.P. 313, *High Holborn, W.C.* 1.	1909-11, 1914-15
1914	*Baker, Wilfred E. Watson, A.Inst.P. 313, *High Holborn, W.C.* 1.	1921-23, 1929-30; Cur. Inst 1921-
1882	Bale, William Mountier. 83, *Walpole-street, Kew, Victoria, Australia.*	
1926	Balfour-Browne, Professor W. A. F., M.A., F.R.S.E, F.Z.S., F.R.E.S., *President.* *Winscombe Court, Winscombe, Somerset.*	1930-33; V.-P. 1933-34. Pres. 1934-
1895	Barnard, Joseph Edwin, F.R.S., F.Inst.P. *Walvens, Eastbury-road, Oxhey, Herts.*	1910-12, Cur. 1913; V.-P. 1913-14, 1934- 1916-17, Hon Sec. 1920-27; 1930-33 Pres. 1918-19; 1928-29
1922	Barnes, John Alfred, M.D., M.R.C.S., L.R.C.P. *Hawarden, Melton-road, Leicester.*	
1923	Barrett, Alfred. *The Chalet, Compton-road, Winchmore-hill, N.* 21.	
1931	Bartlett, Charles Henry. *Tenterden*, 71, *Alexandra-avenue, Luton, Beds.*	
1921	Batchelor, Arthur James. *Croftside*, 3, *Ivyday-grove, Streatham, S.W.* 16.	
1899	Beale, Peyton Todd Bowman, F.R.C.S. *Lymore End, Everton, Lymington, Hants.*	1905
1932	Beardsmore, Thomas Samuel. *The Knoll, Springfield-road, Hinckley, Leics.*	
1885	*Beck, Conrad, *C.B.E.* 69, *Mortimer-street, W.* 1.	1894-1906, 1912-13; 1923-24; 1931; V.-P. 1907-08; 1934- Pres. 1932-33
1918	Berry, John Leslie, M.B., Ch.B. 151A, *New-street, Burton-on-Trent.*	
1913	Bestow, Charles Horton, F.L.S. *Melford-house*, 43, *Upper Clapton-road, E.* 5.	
1919	Bhatia, Bihari Lal, M.Sc., F.Z.S. *Principal, Government College, Hoshiarpur, India*	

Elected.		Service on Council, etc.
1926	Bidder, George Parker, M.A., Sc.D., F.L.S. *Cavendish Corner, Cambridge.*	
1928	Blair, Duncan MacCallum, M.B., Ch.B. *Professor of Anatomy in the University of London, King's College, Strand, W.C.* 2, *and* 71, *Mortlake-road, Kew Gardens, Surrey.*	1932–33 V.-P. 1934–
1903	*Blood, Maurice, M.A., F.C.S. 10, *Park-avenue, Willesden Green, N.W.* 2.	1919–20
1926	Blunderfield, Henry Charles. *Royal Albert Edward Infirmary, Wigan.*	
1927	Borthwick, Sydney. 69, *Mortimer-street, W.* 1.	
1920	Bowell, Ernest W., M.A., M.R.C.S., L.R.C.P. 21, *Prince-road, South Norwood, S.E.* 25.	1925-27, 1930-32
1921	Bowtell, Alexander James. 135, *Dalston-lane, E.* 8.	
1932	Box, Harold Keith, D.D.S., Ph.D., F.A.A.P. 86, *Bloor-street West, and* 261, *Winona-drive, Toronto, Ont., Canada.*	
1931	Boyle, Sydney, F.R.P.S. *Rivoli, North Albert-road, Norton-on-Tees, Co. Durham, and Research Laboratories, Imperial Chemical Industries, Ltd., Billingham-on-Tees.*	
1910	Bracewell, Geoffrey Alfred. *Newlands, Toller-lane, Bradford, Yorkshire.*	
1932	Bracey, Ronald John, F.Inst.P. *Morval,* 15, *Holmdene-avenue, Headstone-lane, North Harrow.*	
1921	Bradbury, J. G., F.R.P.S. 1, *Hogarth-hill, Finchley-road, Hendon, N.W.* 11.	1927–29
1931	Bradshaw, Abel Prescott. *The Café, Dale-road, Rose Hill, Marple, Cheshire.*	
1933	Brailsford, James. 20, *Livingstone-road, Derby.*	
1924	Brambell, F. W. Rogers, B.A., D.Sc., Ph.D. *Professor of Zoology, University College of North Wales, Bangor.*	1927-29, V.-P. 1930-31
1922	Bray, Reginald A., B.A. *Shere, Surrey.*	
1932	Bremer, John Lewis, M.D. *Professor of Anatomy, Harvard Medical School, Longwood-avenue, Boston, Mass., U.S.A., and* 113, *Marlborough-street, Boston.*	
1905	Bridge, John William. *Brewer-street, Maidstone.*	
1921	Brislee, Francis Joseph, D.Sc., F.I.C. *Wayside, Rupert-road, Huyton, near Liverpool.*	

Elected.		Service on Council, etc.
1887	Browne, Edward Thomas, F.Z.S. *Anglefield, Berkhamsted, Herts.*	1900–02
1923	Browning, Edgar W. F. *The Charterhouse, E.C.* 1.	
1911	Browning, Sidney Howard, L.R.C.P., M.R.C.S. 22, *Harley-street, W.* 1.	1922–24; 1932
1926	Bruff, Albert. *High-street, Pershore, Worcs.*	
1925	Bryce, David L., F.R.S.E. *The Ascension Vicarage, Thornhill-avenue, Plumstead, S.E.* 18.	
1923	Bucknill, Thomas, *Barrister-at-law.* 13, *King's Bench-walk, Temple, E.C.* 4.	
1924	Bunning, George Belding. 63, *Third-avenue, Queen's Park, W.* 10.	
1920	Burgess, Arthur Savell, M.A., M.D., B.Ch. *Birch Hanger, Godalming, Surrey.*	1934–
1933	Burgess, Edwin. 6, *Sutton Court, London, W.* 4.	
1934	Burrard, Major Gerald, D.S.O. *Willow Lodge, Hungerford, Berks.*	
1921	Caffyn, Charles Henry. 16, *Bowes-road, Palmer's Green, N.* 13.	
1910	Caird, William John, J.P. *Schoolhouse, Sandhaven, Fraserburgh.*	
1920	Cannon, Herbert Graham, M.A., D.Sc., Sc.D. (Cantab.), F.L.S., F.Z.S. *Professor of Zoology, The University, Manchester.*	1923 25
1913	Capell, Bruce J. 10, *Castelnau, Barnes, S.W.* 13.	
1920	Carleton, H. M., B.A. *Physiology Laboratory, The University, Oxford.*	
1932	*Carpenter, Arthur W. *Explorers Club,* 10, *West 72nd-street, New York City, U.S.A.*	
1925	Carrel, F. Poingdestre. *c/o National Provincial Bank,* 66, *Charing Cross, S.W.*	
1932	Castellani, Sir Aldo, K.C.M.G., D.Sc., M.D., F.R.C.P. 23, *Harley-street, W.* 1.	
1920	Cathcart, Eryk Hayman. *Sunny Bank, Salcombe Regis, near Sidmouth, Devon.*	
1918	Cattley, Major Robert, M.B., C.M., B.Sc., etc. 43, *Main-avenue, Heworth, York.*	
1933	Cauldwell, Rev. Wallace Harrison. *The Manse, Stainland, Halifax.*	

Elected.		Service on Council, etc.
1931	Chandler, Harold Victor. *Helen's Vale, P.O. Box* 821, *Salisbury, Southern Rhodesia.*	
1931	Channon, Harold William. 70, *Lansdell-road, Mitcham, Surrey.*	
1928	Chanter, Alfred Samuel. 2, *Wendron-street, Helston, Cornwall.*	
1922	Charles, William Frederick. *The Nook, Loughborough.*	
1932	Charlton, Miss Edna, B.Sc. 7, *Eaton Court, Eaton Rise, W* 5	
1925	Chatterton, Frederick J. S. 34, *Elm Park-road, Finchley, N.* 3.	
1909	Cheavin, Captain W. H. S., F.C.S., F.E.S. *Middlesex Medical College, Berners-street, W.* 1.	
1904	Cheshire, Professor Frederic John, *C.B.E.*, F.Inst.P. 23, *Carson-road, West Dulwich, S.E.* 21.	1908, 1911-15; 1919; V.-P. 1909-10, 1920-21; 1924-25; Pres. 1922-23
1926	Choat, Ernest Bridgstock, F.Z.S. *Inglewood*, 51, *Bexley-road, Erith, Kent.*	
1930	Clarke, Lionel Percy, L.S.A., M.R.C.S., L.R.C.P. 96, *Grove Park, S.E.* 5.	
1931	Clarke, Peter Trevisa, B.A. *Maze Cottage, Chalfont St. Peter, Bucks.*	
1925	Clarkson, G. D., F.C.S. *St. Paul's-road, Mirfield, Yorks.*	
1934	Clay, Reginald S., B.A., D.Sc., F Inst.P. *Eskdale, Fortis Green, N.* 2.	1926-27, 1934- V.-P 1928-29
1931	Clegg, John. *Extwistle Lodge*, 34, *Scarisbrick New-road, Southport.*	
1924	Clinton, Herbert F. *Dept. of Agriculture*, 605, *Flinders-street, Melbourne, C.3, Victoria, Australia.*	
1907	Clowes, William Archibald, F.Z.S *Duke-street, Stamford-street, S.E.* 1.	
1924	Coales, John Dennis, D.Sc., M.I.E.E. *Berryfield, Fairmile-lane, Cobham, Surrey.*	1928-29
1926	Cockrill, James S. *Gorleston House, Kinross.*	
1924	Cocksedge, Herbert Edwin, M.A., B.Sc. *I.C.I. (Alkali), Ltd., Winnington, Northwich, Cheshire.*	
1925	Codd, Laurence William, M.A. *Bentlands, Addlestone, Surrey.*	
1920	Collins, William G. *The Cambridge & Paul Instrument Co., Ltd., Chesterton-road, Cambridge.*	

Elected. Service on Council, etc.

1908 Connell, John Gibson.
Zoology and Botany Department, Glasgow Provincial Training College, Jordanhill, Glasgow, and 129, *Broomhill-drive, Glasgow, W.* 1.

1920 Cooke, William Edmund, M.D., F.R.C.P., D.P.H., J.P. V.-P. 1927–28 1930–31
Aragon, Swinley-road, Wigan, Lancs.

1931 Corin, Francis Johns, D.D.S., L.D.S.

1927 Coultas, Joseph Arthur.
Orville, Leyton Crescent, Idle, near Bradford.

1922 Crow, William Bernard, D.Sc., Ph.D., F.L.S.
Dept. of Biology, The Technical College, Huddersfield.

1891 Crowther, Henry, M.Sc., F.Z.S.
52, *Brudenell Mount, Hyde Park, Leeds.*

1924 Crundall, Sydney F. W., A.C.G.F.C., A.I.C.
16, *Cliffe-road, Stockton Heath, Cheshire.*

1919 Curties, Charles Lees.
244, *High Holborn, W.C.* 1.

1913 Cuzner, Edgar.
13, *Abbotsford-road, Goodmayes, Essex.*

1932 Davies, Francis, M.D.
Anatomy Department, King's College, Strand, W.C. 2.

1928 Davis, Osborne.
29, *Westbourne-crescent, Canton Bridge, Cardiff.*

1924 Dean, Ernest Samuel.
149, *Widdenham-road, N.* 7.

1927 Denham, R. H. G. Hector.
Rilshaw-lane, Winsford, Cheshire.

1915 Denne, Mark Thomas, *O.B.E.* 1922–24, 1927–28 V.-P. 1925–26
16, *Orchard Court, Worcester Park, Surrey.*

1921 Depew, Ganson.
Marine Trust Co. Building, Buffalo, N.Y., U.S.A.

1920 Derry, Douglas C. L., M.B., B.S. (Lond.).
2, *Hamilton-terrace, St. John's Wood, N.W.* 8.

1928 Desai, Magan.
305, *Hornby-road, Bombay, India.*

1918 *Dixon, Miss Annie, M.Sc., F.L.S.
Kauguri, Batchwood-drive, St. Albans, Herts.

1929 Dixon, Charles William.
Cotswold, Welholme-avenue, Grimsby.

1907 Dowdy, Sidney Ernest, M.P.S.
Harewood, Marine-parade, Dovercourt, Essex.

1919 Drescher, Theodore Bausch.
149, *Westminster-road, Rochester, N.Y., U.S.A.*

Elected		Service on Council, etc
1929	Ducker, Robert Osborne. *27, Spurr-street, Sheffield.*	
1926	Dufty, Rev. Joseph Gibbins. *Meersbrook, Meikleriggs, Paisley.*	
1894	Duncan, Cecil Cooke, F.I.C., F.C.S. *The County Chemical Laboratory, Shire Hall, Worcester.*	
1911	Duncan, Francis Martin, F.R.P.S., F.Z.S. *19, Staverton-road, Brondesbury Park, N.W. 2.*	1917, 1920-23, V.-P. 1918-19, Libr. 1920-24
1919	*Dunn, Gano, A.I.E.E. *J. G. White Engineering Corporation, 43, Exchange-place, New York, U.S.A., and 20, Washington-square, New York.*	
1919	Dunn, Reginald. *90, Lorne-road, Clarendon Park, Leicester.*	
1926	Dunne, Walter John. *Myoora, Irving-road, Toorak, Melbourne, Australia.*	
1922	Du Porte, E. Melville, *Lecturer in Zoology and Entomology.* *Macdonald College, Quebec, Canada.*	
1910	Earland, Arthur. *23, Clive-avenue, Hastings, Sussex.*	1912-15, 1920-21; 1929-30; V. P. 1916-18, 1922; 1931-32
1922	Ellis, Edward Henry, B.Sc. *Gramarye, Farley Green, Albury, Surrey.*	1925 28
1925	Ellis, Holmes. *108, Birtwistle-avenue, Colne, Lancs.*	
1930	Ellis, William Neale, M.P.S. *Beachcroft, The Quay, Appledore, Devon.*	
1928	Else, Walter Martyn. *Fountain-street, Buxton, Derbyshire.*	
1933	Evans, Alan. *10, Avondale-road, Derby.*	
1897	Eyre, John W. H., M.D., M.S.Durh., D.P.H., F.R.S.E., *Professor of Bacteriology in the University of London.* *Bacteriological Laboratories, Guy's Hospital, S.E. 1, and 51, Portland-place, W. 1.*	1904-06; 1909 V.-P. 1907-08; 1910 1922-23; 1927-28 Sec. 1911-19; Pres. 1920-21; Editor 1922-26
1931	Fairhall, Lawrence Turner, M.A., Ph.D., *Assistant Professor of Physiology, Harvard University.* *144, Dickerman-road, Newton, Mass., U.S.A.*	
1921	Falkner, Herbert John. *Gyfu, Barton, St. Mary Church, Torquay.*	
1883	*Fawcett, John Edward. *Heron Court, Farnham, Knaresborough.*	

Elected.		Service on Council, etc
1917	Fendick, Ernest A. *Wicklewood, 22, Finedon-road, Wellingborough.*	
1928	Fikry, Mohammed Aziz, B.A., B.Sc., Ph.D. *Royal Agricultural Society, P.O. Box 63, Cairo, Egypt.*	
1925	Findlay, George Marshall, *O.B.E.*, M.D., D.Sc. *Wellcome Research Institute, Euston-road, N.W.* 1.	1928-32; Editor 1927- V.-P 1933-
1921	Flower, John W. 302, *Alexandra Park-road, Wood Green, N.* 22.	
1933	Ford, John. *Veterinary Laboratory, P.O. Bukuru, Nigeria, W. Africa, and c/o National Bank of India,* 26, *Bishopsgate, London, E.C.* 2.	
1933	Fountain, Anthony Stuart. 55, *Moorgate, Rotherham, Yorks.*	
1932	*Frankel, Jr., Edward, M.D., F.A.C.S. 152, *West* 58*th-street, New York City, N.Y., U.S.A*	
1930	Fraser, Frank Jardine, B.Sc. 66, 5*th-avenue, Ottawa, Canada.*	
1932	Fraser, Roy, B.S.A., M.A. *Professor of Biology and Bacteriology, Mount Allison University, Sackville, New Brunswick, Canada*	
1921	Frith, James Stretton, A.I.C., A M.S.T. *Ascog, Thelwall, Warrington.*	
1930	Frow, Richard Watson. *Wickenby, Lincoln.*	
1933	Fryer, Sydney V. *Veterinary Research Laboratory, Vom, Bukuru, Northern Nigeria.*	
1934	Fuge, Rev. Dingley P. 20, *Scarborough-road, Shipley, Yorks.*	
1929	Fullard, Alfred Fairey. 29, *Hopetown-avenue, Canterbury, Victoria, Australia.*	
1912	Gadd, Arthur. 12, *Chadvil-road, Cheadle, Cheshire.*	
1918	Garbutt, Ernest Chalders. *York House, St. Ives, Cornwall.*	
1931	Garner, Walter, M.Sc. 312, *Kensington-street, Bradford.*	
1919	Garnett, John Benbow. 309, *Oxford-road, Manchester.*	
1920	Gatenby, James Brontë, B.A., D.Phil. (Oxon), D.Sc. (Lond.). *Professor of Zoology, Trinity College, Dublin.*	
1922	Gater, Bossley Alan Rex, M.A., D.I.C., F.E.S. *Professor of Biology, King Edward VII College of Medicine, Singapore, Straits Settlements.*	

Elected.		Service on Council, etc.
1922	Gates, R. Ruggles, M.A., Ph.D., LL.D., F.R.S., F.L.S. *Professor of Botany in the University of London, King's College, Strand, W.C. 2.*	1923–27. 1934– Sec 1928–29, Pres 1930–31; V.-P. 1932–33
1925	Gay, Alfred D., F.C.S., M.S.C.I. 49, *Thornlaw-road, West Norwood, S.E. 27.*	
1921	Ghosh, Ekendranath, M.Sc., M.D. *Professor of Biology, Medical College, Calcutta, India*	
1930	Gillett, William Henry. *Rainbow-street, Sandgate, Brisbane, Queensland, Australia.*	
1921	*Gilpin-Brown, Leslie George. 110, *South Hill Park, London, N.W. 3.*	
1904	Goadby, Sir Kenneth Weldon, *K.B.E.*, M.R.C.S., L.R.C.P. 83, *Harley-street, W. 1.*	
1928	Goddefroy, Ernest, *M.B.E.* 44, *Rue Michel Zwaab, Brussels (Harbour).*	
1928	Gomersall, Percy Phipps. *Grosmont, Byron-avenue, Lincoln.*	
1928	Goode, Edward Francis. 185, *Little Collins-street, Melbourne, Australia.*	
1928	Goosmann, Charles, M.D. 22, *West 7th-street, Cincinnati, Ohio, U.S.A.*	
1922	Gosling, George Walker. *Messrs. Baird & Tatlock (London), Ltd., Eastern Branch, Avenue House, Chowringhee-square, Calcutta, India.*	
1927	Graham, Charles H. Edger. 26, *Gordon-avenue, St. Albans, Christchurch, New Zealand.*	
1933	Graham, David Henry, F.Z.S. 718, *King-street, Dunedin, Otago, New Zealand.*	
1920	Graham, Joseph, B.Sc. *Glen Hurst, Corbridge-on-Tyne.*	
1926	Grainger-Shackles, Alfred. *The Laboratory, Royal Infirmary, Sheffield.*	
1923	Gravelle, Philip O., F.R.P.S. 114, *Prospect-street, South Orange, New Jersey, U.S.A.*	
1933	Gregory, Puthenparampil Joseph, M.A. (Madras). *Puthenparampil, Edathua, Tiruvalla, S. India.*	
1929	Grier, William D. 150, *William-street, New York, N.Y., U.S.A.*	
1904	Griffiths, Waldron. 1, *Cecily-hill, Cirencester.*	
1924	Gurr, George Thomas, F.C.S. 136, *New King's-road, S.W. 6.*	
1912	Gurrin, Gerald Francis. 59, *Holborn-viaduct, E.C. 1.*	

Elected. | | Service on Council etc.

1923 Hagelstein, Robert.
165, *Cleveland-avenue, Mineola, New York, U.S.A.*

1931 Haggis, A. W., F.L.S.
Wellcome Historical Medical Museum, Euston-road, N.W. 1.

1893 Hagler, Elmer Ellsworth, M.D.
The Hagler Building, 401, *East Capitol-avenue, Springfield, Illinois, U.S.A.*

1912 Hall, Rev. Charles A.
Clynder, Lansdowne-road, Worthing.

1920 Hall, T. D. Tuton.
4, *King-street South, Rochdale.*

1924 Hamilton, Thomas Dalling.
Royal College of Physicians Laboratory, 2, *Forrest-road, Edinburgh.*

1930 Hand, Percy George Terry, F.I.C.
The Winnocks, Mayfield-road, Chingford, E. 4

1933 Hanna, G. Dallas, Ph D.
Curator, Department of Paleontology, California Academy of Sciences, San Francisco, California, U.S.A.

1919 Harper, Capt. Raymond Sydney, M.R.C.S., L.R.C.P., R.A.M.C.
36, *First-avenue, Hove, Sussex.*

1930 Harper-Roberts, Herbert John.
34, *College-road North, Liverpool.*

1928 Harris, Alfred Ernest.
44, *Partridge-road, Roath, Cardiff.*

1905 Harris, Charles Poulett, M.D. (Lond.), M.R.C.S., L.R.C.P.
Merrow Down, Newlands-road, Rottingdean, Brighton

1934 Harry, Ralph Gordon, A.I.C.
183, *Cathedral-road, Cardiff.*

1925 Hartley, Isaac.
16, *Fern Bank, Nelson, Lancs.*

1925 Harvey, Leslie A., A.R.C.S., B.Sc., D.I.C.
Zoology Department, University College of the South-West of England, Exeter.

1916 Hazeldine, Frederick James.
Barnfield, South Godstone, Surrey.

1930 Hedayetullah, Syed, M.Sc., Ph.D.
17, *Goaltuli-road, Bhowampur, Calcutta, India.*

1927 Heller, Ernest.
Aurorastrasse 78, *Zurich* 7, *Switzerland.*

1931 Hendey, Norman Ingram, M.P.S. — Cur. Slides 1934–
15, *The Chase, Hillingdon, Middlesex.*

1891 Heron-Allen, Edward, F.R.S., F.G.S., F.Z.S., M.R.I.A., etc. — 1909-10; 1913; 1921-22; V.-P. 1911-12, 1914, 1918-19; Pres. 1916-17
Large Acres, Selsey Bill, Sussex.

Elected		Service on Council, etc.
1910	Hewlett, Richard Tanner, M.D., F.R.C.P., D.P.H., *Hon. Secretary.* *Director of Pathology, Pathological Department, Seamen's Hospital, Greenwich, S.E.* 10, *and* 11, *Crooms Hill, Greenwich, S.E.* 10	1915-16; 1931; Hon. Sec 1932–
1904	*Hill, Cyril Francis, M.Inst.M.M., A.Inst.P., *Treasurer.* *Daresbury Hall, near Warrington.*	1910-12; Treas 1913–
1881	*Hill, Joseph Alfred, F.L S. *St. Bees, Northumberland-road, Leamington.*	
1929	Hiller, Carl R., M.D., F.A.C.S. 19, *West Seventh-street, Cincinnati, Ohio, U.S.A.*	
1929	Hind, Herbert Lloyd. *Stuart House*, 1, *Tudor-street, E.C.* 4.	
1931	Hindle, Professor Edward, M A , Sc.D., Ph.D. *Ormonde Gate, Chelsea, S.W.* 3.	1933–
1932	Hiscott, Leslie Stephenson. *Royal Saracen's Head Hotel, Beaconsfield, Bucks.*	
1906	Hiscott, Thomas Henry, F.L.S. 16, *Woodville-road, Ealing, W* 5, *and* 5, *Stone Buildings, Lincoln's Inn, W.C.* 2.	1917-21, 1924-25; V.P 1922-23
1923	Hobson, A. D., B.A. *Professor of Zoology, Armstrong College, Newcastle-upon-Tyne.*	
1933	Hocking, Frederick Denison Maurice, M B , B S , M Sc , F I C *Upway, Caterham Valley, Surrey*	
1922	Hodgson, Leonard Stanley. *San Remo, Ecclesall-road South, Ecclesall, Sheffield*	
1921	Holder, J. T. 114, *Pepys-road, S.E.* 14.	
1934	Holmes, Herbert, F.C.S. 2, *Wexford-road, Wandsworth Common, S W.* 12.	
1931	Holsinger, Edward Charles Talleyrand. *Lecturer in Biology, Government Training College, Colombo, Ceylon, and Westbrooke, Colpetty, Colombo, Ceylon.*	
1921	Holt, Alfred, F.C.S. *Hedgecroft, Stubbins-lane, Ramsbottom.*	
1934	Horning, Eric Stephen, M.A., D.Sc. *Imperial Cancer Research Laboratories*, 8-11, *Queen-square, London, W.C.* 1.	
1920	Hornyold, Professor Alfonso Gandolfi, D.Sc , F.Z.S. *Villa Soave, Albate, Como, Italy.*	
1921	Horton, William, M.Sc. *Homesefton*, 223, *Queen's-drive, Wavertree, Liverpool.* 15.	
1918	Hoseason, Captain William Sandford. 39, *Sedgecombe-avenue, Kenton, Middlesex.*	
1917	Howard, Henry J., F.L.S. 6, *College-road, Norwich.*	

Elected. | Service on Council, etc.

1930 Howden, Alfred Llewellyn.
Rosalyn, 10, *Milnes-avenue*, *Thornes-road*, *Wakefield*.

1918 Hughes, Owen Lloyd.
The Council School, *Trefnanney*, *Meiford*, *S.O.*, *Montgomeryshire*.

1927 Hugill, William, M.Met.
Langham House, *Fields-road*, *Alsager*.

1922 Hulls, Leonard G., F.C.S., etc.
Rax, *Chidham*, *near Chichester*, *Sussex*.

1929 Humphriss, Eric Lewis Enoch.
21, *Church-road*, *Woolton*, *Liverpool*.

1921 Hunt, Reginald J. H.
Mitylene, *Stanmore-road*, *Harrow Weald*.

1931 Hunwicke, Roderick Francis, B.Sc. (Lond.), A.I.C.
Salisbury Cottage, *Hadley Highstone*, *Barnet*.

1933 Hunter, Robert Angus.
Sanatorium, *Bridge of Weir*, *Renfrewshire*.

1913 Hurrell, Harry Edward.
60, *Albany-road*, *Great Yarmouth*.

1930 Inglesent, Harold.
8, *Sunny Brow-road*, *Archer Park*, *Middleton*, *Manchester*.

1933 *Insch, James.
Messrs. Walter Duncan & Co, 149, *Leadenhall-street*, *London*, *E.C.* 3.

1922 Jackson, James Joseph.
Fern House, 10, *Blake Hall-road*, *Wanstead*, *E.* 11.

1923 Jackson, Joseph Taylor, M.Sc.
Wesleyan Boys' High School, *P.O. Box* 165, *Lagos*, *West Africa*.

1928 James, William McCully, M.D., F.A.C.P.
Box 567, *Ancon*, *Canal Zone*, *Panama*.

1931 Jansen, Pieter Cornelis.
Beeklaan 538, *The Hague*, *Holland*.

1928 Jearey, Bertram Frederick, F.R.A.S.
"*Westhorpe*," *Marais-road*, *Sea Point*, *Cape Town*, *South Africa*.

1925 Jefferies, F. C. B.
Brynmelyn, *Winscombe*, *Somerset*.

1931 Jelley, Edwin Ernest, Ph.D., A.I.C., F.R.P.S.
Kodak Research Laboratories, *Harrow*, *Middlesex*.

1931 Jenkins, Albert Edward.
135, *Burns-avenue*, *Southall*, *Middlesex*.

1922 Jennison, James.
Edale, *Sandy Lodge-road*, *Moor Park*, *Rickmansworth*

Elected		Service on Council, etc.
1928	Johnson, Benjamin King, D.I.C. *Reculver*, 58, *Norton-road, Wembley.*	1932–
1901	Johnson, Charles Harold, M.D., C.M., F.R.C.S.E. 16, *The Ridge, Canterbury, near Melbourne, Victoria, Australia.*	
1929	Johnston, John. 27, *Mecklenburgh-square, W.C.* 1.	
1918	Jones, Sir Bertram Hyde, *K.B.E.* *The White House, Sanderstead Village, Surrey.*	
1910	Jones, William Llewellyn. *Feremina, St. Martin's, Guernsey, Channel Islands.*	
1934	Jopson, Daniel Frederick. *Goff Nook, Nelson, Lancs.*	
1910	Keeley, Frank J., B.S., E.M., *Member of Board of Trustees, Academy of Natural Sciences of Philadelphia.* *Box* 25, *Merion Station, Penna, U.S.A.*	
1925	Kefalas, Andrew, M.A., M.B., Ch.B., F.S.S. 44, *Castle-street, Liverpool.*	
1918	Kidd, Robert Hicks. *Marlborough House, Newbury, Berks.*	
1927	Killick, Charles Rowe, M.B. *Tower Hill, Williton, Somerset.*	
1930	*Klein, Carl Adolphe. 7, *Queen Anne's-grove, Bush Hill-park Enfield, Middlesex.*	
1897	Klein, Sydney Turner, F.L.S., F.R.A.S., F.E.S. *Lilly's, Chelsfield, Kent.*	
1920	Knight-Hallowes, K. A., M.A. (Cantab.), A.R.S.M. (Lond.), F.G.S., A.Inst.M.M., F.Inst.P., Mem.R.S.I. *The Castle, Leighton-Bromswold, Huntingdon*	
1932	Koshy, Thengumparampil Kurian, M.A., Ph.D., F.L.S. *Professor of Botany, H.H. The Maharajah's College of Science, Trivandrum, S. India.*	
1931	Laden, John William. 1, *Glenmere-avenue, Mill Hill, N.W.* 7.	
1920	Lamb, Morris Charles, F.C.S. 176, *Tower Bridge-road, S.E.* 1.	
1932	Langer, Otto. *Woodlands-park, Dorking, Surrey.*	
1923	Larkin, George Frederick, A.M.I.Mech.E. *Essex House, The Fossway, Farndon, Newark-on-Trent.*	
1887	Latham, Miss Vida Annette, M.D., D.D.S. 1644, *Morse-avenue, Roger's-park, Chicago, Ill., U.S.A.*	
1928	Laws, Sydney Gibson. *The Veterinary Laboratory, Entebbe, Uganda, British East Africa.*	

Elected		Service on Council, etc.
1932	Leurquin, Albert C. A., LL.D., D.C.L. *84, Avenue Brugmann, Brussels, Belgium.*	
1931	Lewis, Frank Humphrys. *Paxton House, Bath-road, Reading.*	
1927	Lewis, Frederic Henry, *I.S.O.* 2, *Granville Court, Granville-road, Eastbourne.*	
1932	Lewis, Frederic Thomas, A.M., M.D. *Professor of Comparative Anatomy, Harvard Medical School, Boston, Mass., U.S.A.*	
1931	Linfoot, Sydney, B.Sc. (Lond.) *Holmrook*, 6, *St. Mary's-walk, Harrogate.*	
1919	Lissimore, Norman. *The Clinical Laboratory*, 6, *Victoria-avenue, Harrogate.*	
1926	Lohman, Kenneth E. *U.S. Geological Survey, Washington, D.C., U.S.A*	
1934	Lomax, Joseph Robert. 837, *St. Helens-road, Over Hulton, Bolton, Lancs*	
1927	Long, John A. *Mayhurst, Menston-in-Wharfedale, Leeds.*	
1932	Losch, Paul K., D.D.S 371, *Lexington-street, Auburndale, Mass., U.S.A.*	
1922	Lowe, Frederick Charles. 10, *Buchanan-road, Walsall.*	
1921	Ludford, Reginald James, Ph.D., D.Sc., F.R.H.S. 33, *Lawrence-avenue, Mill Hill, N.W.* 7, *and University College, W.C.* 1.	1922-24, V.-P. 1925-26
1926	McCartney, James Elvins, M.D., Ch.B., D.Sc. 147, *Burnt Ash Hill, S.E.* 12.	1929-31; 1933-
1924	Macdonald, Dudley Keppel. 54, *Stebondale-street, Cubitt Town, E.* 14.	
1929	McDonald, James Stenson. *Human Trypanosomiasis Institute, Entebbe, Uganda.*	
1916	*McEwen, Alfred. *Craig Avel, Tarrytown-on-the-Hudson, New York, U.S.A.*	
1928	Mackinnon, Miss Doris Livingston, D.Sc., F.L.S. *Professor of Zoology in the University of London, King's College, Strand, W.C.* 2, *and* 100, *Oakley-street, Chelsea, S.W.* 3.	1930-31
1921	McLatchie, John Drummond Pryde, M.B., C.M. 34, *Welbeck-street, W.* 1.	
1928	Malcolm, Robert Conacher, F.R.Met.Soc. *Asst. Supt. Mathematical Inst. Office, Survey of India*, 15, *Wood-street, Calcutta, India.*	

Elected. Service on Council, etc.

1911 Mansfield-Aders, Walter, Ph.D.

1921 Manson, John James, L.D.S.
167, *Canning-street, Glasgow, and Bacteriological Laboratory, Dental Hospital, Glasgow.*

1909 Mapp, Charles Richard, B.Sc.
37, *Montpellier-terrace, Cheltenham.*

1931 Mar, Peter G., M.A., M.Sc., F.C.S.
296, *Ellen-street, Winnipeg, Man., Canada*

1904 Mason, Francis Archibald.
29, *Frankland-terrace, Leopold-street, Leeds.*

1925 Mason, William Glanvill, F.B.O.A., F.N.A.O., F.I.O.
Bernvale, Maidstone-road, Chatham, Kent.

1930 Mather, Wilfred, Assoc. M.C.T., F.I.C.
Deepdeen, Audenshaw-road, Audenshaw, near Manchester.

1921 Mathews, Harold J. C., F.C.S.
Beechwood, Reedley Hallows, near Burnley, Lancs.

1929 Matthews, George Pengwerne, D.M.D., L.R.C.P. (Ed.), L.R.C.S. (Ed.), L.R.F.P. & S.
188, *Longwood-avenue, Boston, Mass., U.S.A.*

1933 Matthews, Stephen John.
58, *Longlands-road, Sidcup, Kent.*

1922 Maxwell, Edward Kelly, B.A. 1933–
75, *Bushwood-road, Kew, Surrey.*

1929 Medina, Professor Francisco, M.C., M.S., M.B.
Ave. Condesa 635 *Col. del Valle, Mexico, D.F.*

1879 *Mercer, A. Clifford, M.D.
324, *Montgomery-street, Syracuse, N.Y., U.S.A.*

1899 Merlin, Augustus Alfred Cornwallis Eliot.
107, *Argyle-road, West Ealing, W.* 13.

1924 Michie, John Livingstone, F.C.S.
8, *Wilton Hill-terrace, Hawick, Scotland.*

1924 Millar, William G., M.B., Ch.B.
Pathology Department, University of Edinburgh.

1895 Millard, Edgar James, F.C.S.
35–42, *Charlotte-street, E.C.* 2.

1928 Miller, Ernest George.
Limehurst, 32, *Springfield-road, Wallington.*

1912 Mills, Frederick William, F.L.S.
Woodford Hall, Milton Damerel, N. Devon.

1933 Milton, Edward.
Assistant Curator, Torquay Natural History Society's Museum, Torquay, and 18, *Pine View Gardens, Ellacombe, Torquay, S. Devon.*

1925 Mirza, M. B., B.Sc.
Chairman, Dept. of Zoology, Muslim University, Aligarh, U.P., India.

Elected		Service on Council, etc
1905	Moffat, Eliezar. 75, *High-street, Chatham.*	
1911	Mond, Sir Robert Ludwig, M.A., LL.D., F.R.S.E., F.Inst.P., F.C.S., F.Ph.S., F.G.S., F.Z.S. 9, *Cavendish-square, W.* 1.	
1929	More, Andrew, A.R.C.S., A.R.T.C., F.I.C. *Ellesmere, King's-road, Walton-on-Thames.*	1932-
1924	Morgan, Richard F., Phar.D., *Professor of Botany, School of Pharmacy, University of Buffalo.* 139, *W. Oakwood-place, Buffalo, New York, U.S.A.*	
1932	Morrish, William John, M.D., M.R.C.P., D.P.H. 32, *Thrale-road, Streatham, S.W.* 16.	
1915	Mosley, Frederick Ormrod. *Pinnfold, Church-road, Cowley, Middlesex, and Pathological Laboratory, The Nurseries, Uxbridge, Middlesex.*	
1925	Mottram, James Cecil. *Radium Institute, Riding House-street, W.* 1.	1927-28
1930	Munn, William Faitoute, F.R.S.A. 75, *Walker-road, West Orange, N.J., U.S.A.*	
1900	Murphy, Albert John, F.C.S. 2, *Dorset-square, N.W.* 1, *and Wheathampstead House, Wheathampstead, Herts.*	
1919	Murray, James Alexander, M.D., F.R.S., *Director, Imperial Cancer Research Fund,* 8, *Queen-square, W.C.* 1.	1920 Sec 1921-25; Pres 1926-27, V.-P 1928-29
1930	Myers, Frank J. 15, *S. Cornwall-place, Ventnor, N.J., U.S.A.*	
1914	Nall, George Herbert. *Ayot Lodge, Ayot St. Peter, Welwyn, Herts.*	
1928	Nath, Vishwa, M.Sc., Ph.D. *Lecturer in Zoology, Government College, Lahore, India.*	
1926	Needham, George H., M.Sc. 1679, 23*rd-avenue, San Francisco, California, U.S.A.*	
1890	*Nelson, Edward Milles. 34, *Apsley-road, Clifton, Bristol.*	1892-94; 1902, 1905 V.-P. 1895-96, 1900-01; 1903-04, Pres. 1897-99
1933	Newman, Arthur Samuel. 25, *Hornsey-lane, London, N.* 6.	
1930	Newman, Ivor Vickery, M.Sc. *Tip Tree, Kingsland-road, Strathfield, N.S.W., Australia.*	
1923	Newton, Charles Arthur. 4, *Lansdowne-road, Seven Kings, Essex.*	
1924	Nigam, Mahadeva Prasad, M.Sc. *Professor of Biology, Lucknow Christian College, Lucknow, India.*	

Elected.		Service on Council, etc
1911	Noad, Lewis. *7, King's Bench-walk, Temple, E.C.*	
1924	*Nomani, Mah. *24, Cantonment-road, New Delhi, India.*	
1899	Norman, Albert, L.R.C.P. and L.R.C.S. Edin. *35, Coleherne-road, Earl's Court, S.W.* 10.	
1921	Norman, Albert. *New Haw, Weybridge.*	
1932	North, William Henry.	
1930	Novis, Albert Grabham, M.P.S. *Vandetta, 37, Hova Villas, Hove, Sussex.*	
1925	Nurnberg, Roy Charles Albin. *c/o Messrs. Andrews & George Inc., Shiba Park, Tokyo. Japan.*	
1920	Oakden, Charles H. *30, Meadow-road, Shortlands, Kent*	
1883	Offord, John Milton. *8, Culmington-road, West Ealing, W* 13.	
1927	Ogg, Alexander, B.Sc., Ph.D. *Professor of Physics, University of Cape Town, Cape Town, South Africa.*	
1919	Oppenheimer, Major Frank, I.M.S., M.B., Ch.B., D.T.M., D.T.H., F.R.S.T.M., and H., F.R.I.P.H. *c/o Messrs. Grindlay & Co., Bombay, India.*	
1934	O'Sullivan, Roy Lugarde, L.D.S. *20, Foxholes-road, Southbourne, Bournemouth.*	
1900	Oxbrow, Alfred William. *1, Brigg-street, Haymarket, Norwich.*	
1926	Paine, A. Harold. *The Grey House, 48, Broxbourne-road, Orpington, Kent.*	
1924	Palethorpe, Harry Thomas, M.P.S. *3, Imperial-avenue, Narborough-road, Leicester.*	
1933	Palmer, Kenneth Lewis, F.E.S. *Meadowlea, Gobowen, Salop.*	
1919	Parish, Rev. Herald. *Glenwood, Woodlands-road, Darlington, Co. Durham.*	
1923	Parkes, Alan Sterling, M.A., D.Sc., Ph.D., F.R.S. *National Institute for Medical Research, Hampstead, N.W.* 3.	1926–28; V.-P. 1929–30
1928	Parr, Walter James. *17, Bokhara-road, Caulfield, S.E. 8, Victoria, Australia.*	
1898	Payne, Captain Arthur E. T. *Physiological Laboratory, University of Melbourne, Victoria, and Scotsburn, Toorak, Melbourne, Victoria.*	

Elected		Service on Council, etc.
1884	*Peek, The Honourable Lady. *Hambury Fort House, Honiton.*	
1934	Pentland, Albert. *Criminal Investigation Department, City Police Office, Guildhall, Nottingham.*	
1931	Pickering, John W., D.Sc. *Lecturer on Hæmatology, University of London, King's College, W.C.2, and Sundridge, Russell Hill, Purley, Surrey.*	
1925	Pilditch, F. W. 66, *Tetley-road, Hall Green, Birmingham.*	
1907	Pledge, John Harry. 72, *Nibthwaite-road, Harrow, Middlesex.*	1929–31
1926	Pledger, Robert Howland, B.Sc. *Ewell Castle, Surrey.*	
1902	Poser, Max. 16, *Vick Park B., Rochester, N.Y., U.S.A., and c/o Bausch & Lomb, St. Paul-street, Rochester, N.Y., U.S.A.*	1913
1923	Potter, Herbert. 387, *Moseley-road, Birmingham.*	
1892	Pound, Charles Joseph. *Director, Stock Experiment Station, Yeerongpilly, Queensland, Australia.*	
1930	Preston, John Massey, B.Sc., A.I.C. *Assistant Lecturer in the Department of Textile Chemistry, College of Technology, Manchester, and The Dower House, Euxton, Chorley, Lancs.*	
1933	Price, Herbert. *Woodside, Bradshaw-road, Bolton, Lancs.*	
1931	Prideaux-Brune, Captain Fulke Knatchbull. *Highfield, Dallington, Sussex.*	
1926	Ramanujam, S. G. Manavala, M.A., Ph.D., D.I.C., F Z.S. *Professor of Zoology, Presidency College, Triplicane, Madras, South India.*	
1928	Ramsden, Lt.-Col. Josslyn Vere, *C.M.G.*, *D.S.O.*, M.A., F.R.G.S., F.G.S. *Whiston Priory, Ford, Salop.*	
1896	Ranken, Charles, F.C.S. 11, *Stockton-road, Sunderland.*	
1928	Rao, L. Narayana, M.Sc. *Assistant Professor of Botany, Central College, Bangalore, South India.*	
1921	Rau, A. Subba, D.Sc., B.A. *Department of Physiology, Medical College, Mysore, South India.*	

Elected		Service on Council, etc.
1930	Reddie, John Alexander, F.I.C. *Derwent Lodge, Portinscale, Keswick, Cumberland.*	
1910	Reid, Alfred, M.B., D.P.H., B.Hy. Durh., M.R.C.S. Eng., L.R.C.P., *Goverment Medical Officer.* *Batang Padang Estate, Tapah, Perak, Federated Malay States, and Royal Empire Society, Northumberland-avenue, W.C.* 2.	
1930	Reyersbach, Cecil Douglas. 313, *High Holborn, London, W.C.* 1.	
1899	Rheinberg, Julius, F.Inst.P. *Inglenook*, 12, *Brondesbury-park, N.W* 6	1905–07; 1909–14, 1920–21, 1928–30; 1933–; V.-P. 1915; 1931–32
1928	Rhodes, Henry. *Melbourne Lea, Whitegate, Halifax, Yorks.*	
1927	Rhodes, Herbert William. 7, *Ashburn-place, Ilkley, Yorks.*	
1924	Rhys-Davies, William, F.I.C. 14, *Dock-street, Leeds, Yorks.*	
1893	Richardson, Frederic William, F.I.C., F.C.S., *County Analyst, Bradford.* 30, *Queen's Park-avenue, Bournemouth.*	
1916	Richardson, John. 11, *Observatory-road, East Sheen, S.W.* 14.	
1926	Rigby, John Tomlinson. 21, *Hereford-road, Southport.*	
1929	Rivers-Cole, Harold Robert, L.D.S., R.C.S.Eng., F.Z.S. 23, *Pevensey-road, West Worthing.*	
1928	Roberts, Edward George Treweeke. *Pendennis, Tavistock-road, Launceston, Cornwall.*	
1921	Roberts, William James David. 278, *Station-road, Westcliff-on-Sea.*	
1929	Robertson, Frank John Mead. *Royal Infirmary, Perth.*	
1921	Robins, Edmund Arthur, F.L.S. *Gorran, Cassiobury Park-avenue, Watford, Herts.*	1926–28; 1933–. V.-P. 1929–30
1910	*Robins, Herbert George, F.R.G.S. *Toms Farms, Wankie, S. Rhodesia, South Africa.*	
1917	*Robinson, Miss Nancy M. *Glassel House, Glassel, Aberdeenshire.*	
1927	Robinson, Sydney Harold. *The Homestead, York-avenue, Lincoln.*	
1930	Rohr, Moritz von. Ph.D., M.D. h.c. Jenae. *Professor of Optics, University of Jena*, 511, *Moltkestrasse, Jena, Germany.*	
1921	Room, H. W. Reginald. *Grey Russet, Edward-road, Bromley, Kent.*	
1924	Rosenberg, Augustus. *Tollard Royal, Bournemouth.*	

Elected		Service on Council, etc.
1929	Rosenberger, Heinz. *Sandy Hook, Connecticut, U.S.A.*	
1911	Ross, John Pilkethly, M.P.S. *P.O. Box* 228, *Bombay, India.*	
1904	Ross-Mackenzie, John, F.C.S. *Woodleigh, Selborne-road, Barbourne, Worcester.*	
1931	Ross, Robert, M.A. *British Consulate General,* 360, *N. Michigan-avenue, Chicago, Ill., U.S.A., and c/o Foreign Office, London.*	
1932	Row, R. Madhava, B.A. (Madras). *Vishram Bang,* 55, *Rutcherry-road, Mylapore, Madras, India.*	
1918	Rowley, Frank, M.I.M.M. *The Bouldnor, Yarmouth, Isle of Wight.*	
1897	Rowley, Frederick Richard. *Curator, Royal Albert Memorial Museum, Exeter, and* 4, *Victoria Park-road, Exeter.*	
1917	Ryland, Lieut.-Colonel Alfred W. 30, *Higher Bank-road, Fulwood, Preston.*	
1922	Saguchi, Professor Sakae. *Kanazawa Medical College, Kanazawa, Japan.*	
1918	Salmon, Walter. *Sandiway,* 66, *Goldieslie-road, Wylde Green, Birmingham.*	
1923	Sansom, George Samuel, D.Sc. *Kennel Moor, Milford, Surrey.*	1929–31; 1934– V.-P. 1932–33
1932	Sartory, Peter Karel. 34, *Elm-grove, Harrow Garden Village, Rayner's Lane, Harrow, Middlesex.*	
1909	Saxton, Thomas R., Assoc.M.Inst.C.E. 43, *East Bank, Stamford Hill, N.* 16.	
1928	Sayeeduddin, Mohammed, M.A., B.Sc. *Professor of Biology, Osmania University College, Hyderabad-Deccan, India.*	
1925	Schmehlik, R. *Berlin-Dahlem, M. Schwarzen Grund* 25, *Germany.*	
1925	Schoonhoven, John J., M.A. 773, *Eastern Parkway, Brooklyn, N.Y., U.S.A.*	
1913	Scott, Wm., F.R.C.V.S. *Frian House, Bridgwater.*	
1900	*Scourfield, David J., *I.S.O.*, F.L.S., F.Z.S. 6, *Chadwick-road, Leytonstone, E.* 11.	1908–13; 1924–25; 1930– V.-P. 1914–15; 1921–22; Sec. 1916–20
1907	Scriven, Charles R. *Deepdene, North Side, Streatham Common, S.W.* 16.	
1917	Sears, R. S. W. 1, *Lisson-grove, Marylebone, N.W.* 1.	
1924	Setna, Sam B., B.Sc., M.Sc., Ph.D. *Pillo Minar,* 15, *Walton-road, Appolo Reclamation, Bombay, India.*	

Elected.		Service on Council, etc.
1926	Sheard, Hubert V. *Hollin Deane, Rigton-lane, Bardsey, near Leeds.*	
1929	Sheldrake, Reginald Alfred, M.P.S. 41–43, *Appleton Gate, Newark-on-Trent.*	
1885	*Shelley, Major A. D. G., R.E. (retired). *Hitherbury, Portsmouth-road, Guildford.*	
1910	Sheppard, Alfred William, F.L.S. *c/o Longmans, Green & Co.*, 39, *Paternoster-row, E.C.* 4.	1914–15; 1917–19
1909	Sheppard, Edward James. 137, *Kennington-road, Lambeth, S.E.* 11.	1916–22; 1928–33 Cur. Slides 1914– V.-P. 1923–24
1909	Sidwell, Clarence J. H. 46, *Ashbourne-grove, East Dulwich, S.E.* 22.	
1929	Siedentopf, Prof. Henry F. W., Dr. Phil. and Ing. *Kaiser Wilhelm Strasse*, 7, *Jena, Germany.*	
1930	Silva, U. D. Solomon de. 53, *High-street, Teddington, Middlesex.*	
1912	Simpson, Norman Douglas, M.A., F.L.S. *Maesbury, Cavendish-road, Bournemouth, Hants.*	
1929	Smart, James William, A.L.A.A. 16, *Caldbeck-avenue, Worcester Park, Surrey.*	
1924	Smiles, John, A.R.C.S., *Hon. Secretary.* 22, *Coniston-road, Muswell Hill, N.* 10.	1932–33 Hon. Sec. 1934–
1931	Smith, Alton Ewart Clarence, M.A., A.I.C. *University College, Southampton.*	
1925	Smith, Charles A. 36, *Singleton Scarp, Woodside Park, Finchley, N.* 12.	
1917	Smith, Joseph, F.S.A.A. *Kenwyn*, 90, *Kenwyn-road, Ellacombe, Torquay.*	
1930	Smith, Robert Low, F.C.S. 70, *Grove Park-road, Mottingham, S.E.* 9.	
1897	Soar, Charles David, F.L.S. *The Crossways, Hertford Heath, Herts.*	1915–16
1934	Spector, Benjamin, M.D. *Professor of Anatomy, Tufts College Medical School,* 416, *Huntingdon-avenue, Boston, Mass., U.S.A.*	
1918	Springall, Hubert F. *The Friars, King's Lynn.*	
1909	Stewart, Thomas S., M.D. 1532, *Pine-street, Philadelphia, Pa., U.S.A.*	
1900	Stiles, Matthew Henry. 10, *Avenue-road, Doncaster.*	
1921	Stobart, Captain Henry Francis. *Haldon House, Dunchideock, Exeter.*	
1914	Strachan, James, F.Inst.P. *The Orchard, Hook Green, Meopham, Kent.*	

Elected		Service on Council, etc.
1923	Stream, Ernest John, M.A. (Cantab.), F.L.S. *Burnham, Grosvenor-road, Orpington, Kent.*	
1906	Swift, Mansell James. 81, *Tottenham Court-road, W.* 1.	
1934	Subramaniam, M. K., B.A. *University Zoological Laboratory, Chepauk Post, Madras, South India.*	
1925	Talmage, Sterling Booth, M.Sc., Ph.D. *Professor of Geology, New Mexico School of Mines. Socorro, New Mexico, U.S.A.*	
1932	Tanner, Frederick John. 13, *King's Park-road, Bournemouth.*	
1900	Taverner, Henry. *Wrekin House,* 319, *Seven Sisters-road, Finsbury Park, N.* 4.	
1934	Thalmann, Hans E., Ph.D. *Hallerstr,* 52, *Berne, Switzerland.*	
1933	Thompson, Keith S., M.R.C.S., L.R.C.P. *Department of Pathology, The University, Edmund-street, Birmingham.*	
1929	Thuringer, Joseph Mario, M.D. *School of Medicine, University of Oklahoma, Oklahoma City, Oklahoma, U.S.A.*	
1912	Tierney, Clarence, D.Sc., F.L.S., *Secretary.* *Coulsdon, Surrey, and Athenæum Club, S.W.*1.	1921-22, 1925; V.-P. 1923-24; Sec. 1926- Libr. 1929-
1923	Titchener, George R. 10, *Dalberg-road, Brixton, S.W.* 2.	
1926	Titchener, J. B. *Hatherwood, Manor Way, Beckenham, Kent*	
1925	Toorkey, Dinshaw Rustumji, M.A., B.Sc. 133, *Prendergast-road, Secunderabad, Deccan, India.*	
1925	Troughton, Henry George. 5, *Stone Buildings, Lincoln's Inn, W.C.* 2.	
1932	Tucker, Quincy C., C.Ph.M., U.S.N. 3674, *Forty-second-street, San Diego, California, U.S.A.*	
1934	Verleyen, E. J. B. *Leopold Kraag,* 24, *Antwerp.*	
1913	Verrall, Frederick H., B.A., LL.B. *The Hollies, Worthing, Sussex.*	
1926	Vickers, A. Eric J., M.Sc., F.C.S., F.I.C. *Hazeldine, Junction-road, Norton-on-Tees, Co. Durham.*	
1928	Wagstaffe, Reginald. *Municipal Museum, Vernon Park, Stockport.*	

Elected. | Service on Council, etc.

1933 Waldron, Lawrence R., M.A., Ph.D.
Dept. of Agronomy, State College Station, Fargo, North Dakota, U.S.A.

1933 Walker, Eric Millson, A.T.I.
24, *Epperstone-road, West Bridgford, Nottingham.*

1923 Wallis, Thomas Edward, B.Sc., F.I.C., Ph.C.
21, *Sunbury-avenue, Mill Hill, N.W.* 7.

1909 Walter, Rev. Frederick William.
The Manse, Burley, Hants.

1929 Walton, Robert, F.C.S.
Alexandria Water Co., Rond Point Laboratory, Alexandria, Egypt.

1929 Warton, William Shakespeare.
35, *Doneraile-street, S.W.* 6.

1919 Watkinson, Harry.
Westwoods, Welholme-road, Grimsby.

1928 Watts, Thomas William, H.D.D. (Edin.), L.D.S., R.C.S. (Eng.).
8, *Castle Meadow, Norwich.*

1932 Weatherford, Harold Lorraine, M.A., Ph.D.
Asst. Professor of Histology, Harvard Medical School, 240, *Longwood-avenue, Boston, Mass., U.S.A.*

1912 Webb, Wilfred Mark, F.L.S.
The Hermitage, Hanwell, W. 7.

1927 Welch, Archibald Parker.
19, *Lincoln Gardens, The Drive, Ilford, Essex.*

1924 Welch, Frank Victor.
26, *Dallas-road, Hendon, N.W.* 4.

1928 Wetzel, Reinhard A., B.S.
218, *Tecumseh-avenue, Mount Vernon, N.Y., U.S.A.*

1919 Whipp, James Ewart, M.P.S., F.C.S.
3, *Snowdon View, High-street, Prestatyn, N. Wales.*

1933 Whitfield, Frank G. S.
Wellcome Tropical Research Laboratories, Khartoum.

1920 Whitfield, Herbert Charles.
6, *Kassala-road, Battersea Park, S.W.* 11.

1898 *Whittaker, Oscar, F.E.S.
Rivington, Teignmouth-road, Torquay.

1931 Wiedling, Maximilian.
20, *Mortimer-street, London, W.* 1.

1910 *Wilding, Percy P.
Baragh House, Priory-lane, Penwortham, Preston, Lancs.

1921 Wildman, J. T. R.
36, *Etherley-road, South Tottenham, N.* 15.

1931 Williams, Henry.
25, *Greenways-crescent, Kingston Manor Estate, Shoreham-by-Sea.*

Elected.		Service on Council, etc
1922	Williamson, William, F.R.S.E., F.L.S. 7, *Ventnor-terrace, Edinburgh.*	
1911	Wilton, Edmund Wade, A.I.S.E., F.S.A., F.Z.S. *Clifton Villa, Avenue-road, Scarborough.*	
1925	Winter, Frank. 2, *Duke-street, S.W.*	
1923	Woodger, Arthur George. 530, *Great Western-road, Glasgow.*	
1889	Wright, Charles Henry. *Kew Cottage, Townsend, Seaton, S. Devon.*	
1925	Wright, Rev. Frederick James, M.B.A.A. *St. Mark's Vicarage, Stockland Green, Birmingham.*	
1925	Wright, H. Cameron. *Sherwood Park Clinic and Spa, Sherwood Park, Tunbridge Wells.*	
1921	Wrighton, Harold, B.Met. 21, *Archery-road, Eltham, S.E.* 9	1924-26; 1932-33
1919	Wycherley, Sydney R. *Netherleigh, Keswick-road, Orpington, Kent.*	
1928	Yarwood, Albert Reginald. *Herne, Gravel-lane, Banks, near Southport, Lancs*	
1890	*Youdale, William Henry.	
1933	Young, Herbert John. 66, *Wandle-road, Morden, Surrey*	
1920	Zwick, Karl George, Ph.C., Ph.D., M.D. *Doctors' Building, Garfield-place, Cincinnati, U.S.A., and* 3444, *Cornell-place, Clifton, Cincinnati, Ohio, U.S.A.*	

HONORARY FELLOWS.

Elected.

1879 Balbiani, E. G.
Paris.

1929 Chapman, Frederick, A.L.S., F.G.S., Hon. F.R.S. Sth. Australia.
Melbourne, Victoria, Australia.

1930 Farmer, Prof. Sir John Bretland, M.A., D.Sc., LL.D., F.R.S.
Bath.

1931 Fujii, Prof. K.
Tokyo.

1931 Grégoire, Prof. Victor.
Louvain.

1933 Hadfield, Sir Robert A., Bart., D.Sc., F.R.S., F.Inst.P.
London.

1933 Jackson, Sir Herbert, *K.B.E.*, F.R.S., F.I.C.
London.

1905 Jennings, H. S.
Baltimore.

1934 Küster, Professor Ernst.
Giessen University, Germany.

1912 Penard, Dr. Eugene.
2, *Rue Töpffer, Geneva.*

1904 Ramón y Cajal, S.
Madrid.

1923 Rendle, Alfred Barton, M.A., D.Sc., F.R.S., F.L.S., etc.
Leatherhead, Surrey.

1929 Rhumbler, Dr. Ludwig.
Münden.

1931 Rosenberg, Prof. Otto.
Stockholm.

1905 Wilson, Prof. Edmund Beecher.
New York.

1929 Winiwarter, Prof. Hans de.
University of Liége, Belgium.

1905 Wood, R. W.
Baltimore.

Past-Presidents.

	Elected.
*Sir Richard Owen, *K.C.B.*, D.C.L., M.D., LL.D., F.R.S.	1840–1
*John Lindley, Ph.D., F.R.S.	1842–3
*Thomas Bell, F.R.S.	1844–5
*James Scott Bowerbank, LL.D., F.R.S.	1846–7
*George Busk, F.R.S.	1848–9
*Arthur Farre, M.D., F.R.S.	1850–1
*George Jackson, M.R.C.S.	1852–3
*William Benjamin Carpenter, *C.B.*, M.D., LL.D., F.R.S.	1854–5
*George Shadbolt	1856–7
*Edwin Lankester, M.D., LL.D., F.R.S.	1858–9
*John Thomas Quekett, F.R.S.	1860
*Robert James Farrants, F.R.C.S.	1861–2
*Charles Brooke, M.A., F.R.S.	1863–4
*James Glaisher, F.R.S.	1865–6–7–8
*Rev. Joseph Bancroft Reade, M.A., F.R.S.	1869–70
*William Kitchen Parker, F.R.S.	1871–2
*Charles Brooke, M.A., F.R.S.	1873–4
*Henry Clifton Sorby, LL.D., F.R.S.	1875–6–7
*Henry James Slack, F.G.S.	1878
*Lionel S. Beale, M.B., F.R.C.P., F.R.S.	1879–80
*Peter Martin Duncan, M.B., F.R.S.	1881–2–3
*Rev. William Henry Dallinger, M.A., LL.D., F.R.S.	1884–5–6–7
*Charles Thomas Hudson, M.A., LL.D. (Cantab.), F.R.S.	1888–9–90
*Robert Braithwaite, M.D., M.R.C.S.	1891–2
*Albert D. Michael, F.L.S.	1893–4–5–6
Edward Milles Nelson	1897–8–9
*William Carruthers, F.R.S., F.L.S., F.G.S.	1900–1
*Henry Woodward, LL.D., F.R.S., F.G.S., F.Z.S.	1902–3
*Dukinfield Henry Scott, M.A., Ph.D., LL.D., F.R.S., F.L.S.	1904–5–6
*The Right Hon. Lord Avebury, P.C., D.C.L., LL.D., F.R.S., etc.	1907–8
*Sir Edwin Ray Lankester, *K.C.B.*, M.A., LL.D., F.R.S., F.L.S., F.Z.S.	1909
*Sir J. Arthur Thomson, M.A., F.R.S.E.	1910–11
*Henry Geo. Plimmer, F.R.S., F.L.S., F.Z.S., etc.	1911–12
*Sir German Sims Woodhead, M.A., M.D., LL.D., F.R.S.E., etc.	1913–15
Edward Heron-Allen, F.R.S., F.L.S., F.G.S., etc.	1916–17
Joseph E. Barnard, F.R.S., F.Inst.P.	1918–19; 1928–29
John H. Eyre, M.D., M.S., F.R.S.Edin.	1920–21
Frederic J. Cheshire, *C.B.E.*, F.Inst.P.	1922–23
*A. Chaston Chapman, F.R.S., F.I.C., F.C.S.	1924–25
James A. Murray, M.D., B.Sc., F.R.S.	1926–27
R. Ruggles Gates, M.A., Ph.D., LL.D., F.R.S., F.L.S.	1930–31
Conrad Beck, *C.B.E.*	1932–33

* Deceased.

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